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ISSUE STUDY ON SOLID WASTES

Consumer Protection and Environmental Health Service
Washington, D. C.

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ISSUE STUDY ON SOLID WASTES

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FOREWORD

The HEW Secretary has accented the urgency of seeking more effective approaches and solutions to all major health and welfare problems including those related to consumer protection and environmental health. In setting out the CPEHS strategy the Administrator has placed emphasis on the sharing of responsibility with industry and on improvement of State and local capabilities.

The development of our CPEHS operational tactics imposes the requirement for a critical review and evaluation of both discrete and broad issues bearing on the most efficacious approaches to our problems. The CPEHS planning system provides the vehicle through program-analysis studies to assemble exceptional skills from all spheres of Government, industry and professions to study these related issues.

Thus the Departmental and CPEHS FY 1971-1975 planning cycle has included as a critical element, the selection of a series of carefully selected issues for study. They will hopefully suggest alternate steps that can be taken in providing needed solutions and will at the least provide bases for objective policy level decision-making.

This particular study is one in the current series. In it the study group has within a limited time-frame, examined the dimensions of the problem very critically and presented carefully chosen recommendations for consideration in forward-planning.

Follow-up studies or a more in-depth broad study may be needed to succeed this one. If such is the case they will be handled in succeeding fiscal years and made an integral part of the planning process.

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Preface

The following report represents an initial step in the development of comprehensive and detailed program plans whose objective is to achieve effective, reliable, economic handling and disposal of the Nation's solid wastes so that the quality of our environment is not degraded, the public health is not adversely effected and natural resources are not wasted.

In a major sense it is a guide for the detailed planning that must be carried out on a continuing basis. Much of the quantitative inputs, evaluation of alternative approaches, economic analyses, and results of other types of studies must be developed before the more detailed and reliable planning base can be erected. Indeed, meeting these latter requirements is among the important initial objectives of the "plan" in its current form.

The concepts of considering the problems of solid waste management from the technological base of materials handling and within the framework of a waste source--materials flow chart matrix are believed to provide reasonable initial bases or approaches for systematic analyses of these problems and development of refined program plans. While the current program operations are in progress and reasonably effective at their current scale, it is clear that major program expansions are required and that the detailed planning of such expansions must be considered as top priority in the overall program.

Joseph A Lieberman

Joseph A. Lieberman
Chairman

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PART I
SUMMARY AND
RECOMMENDATIONS

PART I
SUMMARY AND RECOMMENDATIONS

SUMMARY & CONCLUSIONS

I. INTRODUCTION

A. General

The immutable laws of nature decree that man can neither create nor destroy matter. He uses, transforms, distributes, redistributes and, in these processes, at some point produces wastes--solid, liquid, or gaseous.

This report is concerned with the management of solid wastes. While the interrelationships between the state of waste matter and our land, water, and air environments must be recognized, certain unique factors associated with solid wastes are major determinants of the strategy and tactics for attacking the problem of managing these wastes.

Mobility is probably the most important of these factors. Solid wastes are comparatively immobile in the sense that, unlike gaseous or liquid wastes, they are not subject to a natural, continuously operating transport system in the atmosphere or hydrosphere. Solid wastes, in general, stay where they are generated unless transported by man. The majority of solid wastes are deposited on land, they are not carried by natural forces across political boundaries, and the problems are comparatively localized.

Another important factor that is unique to solid wastes and its relation to the environment, relates to the concepts of pollution abatement and control that have been generally applied to air and water pollution. In the latter, abatement or control is based on the amounts or concentrations of specific pollutants which would be allowed in our air and water resources. In the case of solid wastes the management rationale must be based on proper materials handling and disposal in concentrated form at some location in a reliable, economical and effective manner that does not adversely affect public health or degrade the quality of the environment.

The above unique features of solid waste management impinge significantly on all facets of the problem--technological, administrative, legislative, institutional, regulatory and economic.

B. Scope and Nature of the Problem

In order to properly delineate the structure and details of the problems of management of solid wastes it is essential to start from a technological base, namely, materials handling, including reclamation and reuse. This in no way diminishes the importance of the administrative, i.e., socio-political-economic aspects that are integral to the total problem. Indeed, it is often in these latter sectors that the key determinant to successful solid waste management is found and these aspects obviously be included in any viable overall systems approach to problem solution. But technically feasible, economically acceptable physical processes and procedures for effectively handling solid wastes materials are the basic prerequisite--and the socio-political-economic sectors must produce effective arrangements and mechanisms for putting the physical processes and procedures into practice.

In proceeding systematically from a materials handling base, it is rational and convenient to use a simplified matrix with one axis covering the segments of a materials flow chart, i.e. generation, storage, collection, transport processing, disposal and the other axis showing the source or origin of the wastes, i.e. residential, commercial, industrial, agricultural, institutional. (Fig. 1 page 6).

In using such a matrix it must be recognized that 1) reclamation and reuse flow charts can stem from various points of segments in the flow chart axis and 2) individual elements of the matrix are not necessarily unique. In general, important unifying factors in considering such a matrix are quantities and characteristics of materials

Figure 1

Simplified Solid Waste Management Matrix

	1	2	3	4	5
Waste Source	Residential	Commercial	Industrial	Agricultural	Institutional
Flow Chart Segment					
A. Generation	X	X	X	X	X
B. Storage	X	X	X	X	X
C. Collection	X	X	X	X	X
D. Transport	X	X	X	X	X
E. Processing	X	X	X	X	X
F. Disposal	X	X	X	X	X
G. Management	X	X	X	X	X
Legislation	X	X	X	X	X
Financing	X	X	X	X	X
Socio-Political Arrangements	X	X	X	X	X

(solid wastes) to be handled in a particular flow chart segment or segments. In other words, the central initial questions are:

1) How much of this material must be handled?
2) What are the characteristics (physical, chemical, etc.) of the material?
3) What specifically, in a materials handling, reclamation, and reuse sense is the next thing that has to be done with the material in an over-all systems framework?
4) What are the physical procedures or processes (unit operations) that will most effectively accomplish the steps in 3) above?

C. Description of the Problem--Gross Statistical Parameters

1. U. S. population which is now over 200 million, is rapidly urbanizing (now 70 percent) thus concentrating municipal and industrial solid waste management problems.
2. Dramatic increase in per capita generation of municipal solid waste from 2.75 lb. in 1920 to 5.3 lb. today has accompanied the population explosion and is compounding the problem. The figure is expected to reach 8 lb. by 1980.

3. Total solid waste generated in U. S. creates problems because of its gigantic volume.

    Residential & Commercial - 250 million tons/year
    Industrial - 110 million tons/year
    Mineral - 1.1 billion tons/year
    Agricultural - 2.0 billion tons/year
    Total Approx. 3 1/2 billion tons/year

4. The total public solid waste bill for the nation is 4.5 billion dollars per year to handle residential, commercial and industrial solid waste. This represents about 1/2 of 1 percent of our gross national product. Approximately 75 percent of the cost is associated with the collection and transport of this material.
5. The predominant method of solid waste disposal is land deposition. Incineration is the most prevalent treatment process in use. 94 percent of all land disposal operations and 75 percent of all municipal incinerators are unsatisfactory from the standpoint of public health, effectiveness of operations, or protection of natural resources.
6. Packaging wastes and disposable containers causes special problems by a) making significant contributions (52 million tons/year) to over-all waste loads, b) providing

the major source of litter and thus the desecration of the natural beauty of the landscape, c) wasting valuable resources and d) causing special problems in disposal operations, e.g. incineration of plastic wastes. In a typical year this country throws away 30 million tons of paper, 4 million tons of plastic, 48 billion cans and 26 billion bottles.

7. Agricultural wastes are causing problems because they are increasingly concentrated near urban centers in feedlots and other concentrated operations rather than evenly spread throughout rural areas.
8. Demolition wastes from urban renewal activities create severe problems in handling and disposal.
9. Small communities have not learned to join together to pool resources and approaches on a regional basis to take advantage of economy of scale resulting in more effective operations at less cost.
10. The four segments of the flow chart (storage, collection, transport, and processing) between generation and disposal directly and intimately affect an estimated 80 percent of the population. The reduced public visibility of the

disposal segment accounts for the comparatively poor state of these operations both in terms of expenditure and effectiveness.

II. MAJOR SELECTED ISSUES

The issues or problem areas concisely delineated below are covered in greater detail in Part 2. Although they relate in varying degree to different levels of government, they should be considered in the context of a total system. They indeed represent the components of a "Strategy for a Cleaner America Through Solid Waste Management."

A. Inadequate application of existing technology

There is existing technology to cope with many of the problems of solid waste management. The lack of application of existing technology is due to the more significant factors listed below.

1. Inadequate policy decisions to attack the problem
2. Lack of money and financing systems (Federal, State, local, private)
3. Socio-political deficiencies and attitudes
    a. Inadequate societal interest and concern (the will to do something about the problem)
    b. Inadequate institutional structures and arrangements and operational management
    c. Inadequate legislation, ordinances, regulatory systems
    d. Inadequate availability of information on current technology
4. Lack of qualified personnel

B. Deficiencies in necessary information and data base

An adequate information and data base is obviously an essential prerequisite to adequate definition of problems requiring solution. Most information that is currently available is sketchy and inadequate, resulting in intuitive or ill-defined attacks on specific problems. The major deficiencies that comprise this issue are:

1. Quantity and characteristics of wastes generated from all sources is needed in greater detail and on more extensive basis.
2. Cost and accounting data are woefully inadequate yet essential for economic analyses and evaluations.
3. Information on the nature and effectiveness of many current practices, systems, unit operations, and components is sketchy.
4. Lack of standards in terminology and measurement.

C. Requirement for improved, new, and alternative process systems, unit operations, and components

The "technology" currently being applied to solid waste management is not significantly different than that used 25-35 years ago. The absence of an adequate modern "r&d" approach to this whole problem area is now clearly handicapping our capability to cope with the increasing quantities and new and complex solid waste materials. New and improved technology is needed:

1. To vastly upgrade reclamation and reuse of economically recoverable fractions of solid waste
2. To provide greater economics and choice in system design
3. To increase system mechanization and reduce labor requirements significantly, thereby reducing costs and improving efficiency

D. Deficiency in information and data on social and psychological attitudes of people and institutions regarding solid wastes

An aroused, effective informed "public constituency" determined to improve our solid waste situation is the keystone to progress. Some of the "people questions" needing investigation are:

1. Why do people befoul their own immediate environment?
2. What is their attitude toward paying for adequate solid waste management?
3. Are there acceptable bases and techniques for effective regulation and control?
4. How convenient must transfer stations and disposal facilities be to encourage public use?

E. Training and Manpower Development

The national manpower needs of solid waste management systems must be met by an effective manpower development and training program. Such a program, participated in by government, industry, labor and the educational system must take into account the social and economic status assigned to the solid waste worker, the inordinately high accident rate experienced in the field and the need for professional technical and management personnel. Two of the major manpower requirement areas are those related to:

1. Design, construction, operation, and management of effective solid waste management systems
2. Conduct of r&d and demonstration and test programs

F. Industry Involvement and Participation

While private enterprise is currently engaged in the business of solid waste management, it is almost exclusively in the form of small, uncoordinated operations. Modern industrial production and management expertise has much to offer in solution of solid waste management problems in terms of:

1. A specific waste generator
2. A contributor to problem solution and participant in 4.5 billion, or greater, business (business enterprise opportunity in supplying hardware and services)

G. Federal Agency Interfaces and Coordination

It is to be expected that a number of Federal agencies have interests and concerns related to solid waste management. The interfaces between the HEW programs (where leadership responsibility resides under the Solid Waste Act) and these other agencies have not been adequately defined. It necessarily follows that mechanisms for managing these interfaces to assure effective over-all program prosecution have not been developed. Past reorganizations of the programs in HEW and personnel and budget constraints have been significant contributing factors in this regard. In any case, it is essential for DHEW to exercise its assigned leadership role in initiative actions with the Agencies listed below and in the President's Environmental Quality Council.

1. Bureau Solid Waste Management (CPEHS/ECA) in DHEW
   central lead role (Solid Waste Disposal Act - P.L. 82-272)
2. HUD - whole spectrum of priority urban problems
3. Agriculture - solid wastes from growing animals,
   food, fibre, and forest products on agricultural land
4. Interior - solid wastes from fuel and mineral industries
   solid wastes from National Parks
   relation to water pollution
5. NAPCA in CPEHS - relation to air pollution
6. Other
   DOT - regulation of dumps and junkyards within
   1,000 feet of Federally financed roads
   DOD - solid waste management at major defense
   installations

III. PROGRAM BACKGROUND

A. Role of Federal Government

The role of the Federal Government and the rationale for this role is delineated in Section 202 of the Solid Waste Disposal Act. Basically it is recognized that the problems of solid waste management and their relation to the quality of the environment and of life are increasing because of our national growth and advancing technology and industry, and impact on essentially the total population of the country, with particular emphasis and priority on the urban situation.

While it also recognizes that the management and operation of solid waste management systems must continue to be primarily the responsibility of State, regional, and local agencies, it emphasizes the Federal role as a catalyst for action through technical and financial assistance and through leadership in attacking administrative and legal questions. Although technical and management resources at the State, regional, and local level are expected to continue to be upgraded, it is essential that the Federal role continue to increase through the next five to ten years, and, because of the over-all environmental health and national resource aspects of the problem, will be necessarily a continuing one beyond that period, perhaps at a reduced or maintenance level.

B. Organization in DHEW

The acknowledgment of solid waste as an important national problem intimately associated with conserving the quality of our environment stems from the passage of the Solid Waste

Disposal Act of October 1965 (P.L. 89-272). Although before that time (during the late 50's and early 60's) the Public Health Service was the major agency in the Federal Government responsible for air and water pollution control and abatement, its programs in solid waste were quite limited in scope and had only meagre budget support. With the passage of the Act, which extended to 1970 and authorized up to a $20 million per year expenditure, an Office of Solid Wastes was created. Through subsequent changes in organization it became the Solid Wastes Program within the National Center for Urban and Industrial Health (January 1967) and the Bureau of Solid Waste Management (January 1969). The lack of organizational stability has hampered the development of DHEW solid waste programs.

C. Program Progress and Accomplishments

As noted previously, the Solid Waste Disposal Act was passed in October 1965 so the program to implement the provisions of the Act is comparatively young. Since the passage of the Act accomplishments have included the following:

1. Successful initiation of basic data gathering surveys. The first in-depth national survey of community solid waste management conditions will be completed in the early 70's and preliminary results have been reported and published.* Because of the enormity of this

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*Interim Report of the National Survey of Community Solid Waste Practices. October 1969, Bureau of Solid Waste Management undertaking (the first such comprehensive survey in the United States, the first national survey must necessarily be related to problem definition data only. It will, however, paint the "big picture" of what local government is doing in solid waste management, and the current level of operation of solid waste management facilities. More detailed studies have been initiated to develop a data base in industrial solid waste management systems; precise quantification and characterization of residential solid waste; a detailed definition of the investment of the private sector in solid waste management; and the effluent characteristics, etc. of municipal incinerators.

2. As a result of State planning grants, 41 States, 2 territories and 4 interstate agencies have now initiated the development of comprehensive State solid waste management plans. Before 1965, few States had full-time employees assigned to the management of solid wastes. Prior to 1965, less than 10 man years per year were devoted to planning for solid waste management at the State level. Today, over 200 man years per year are being directed at this very important activity.
3. Through the mechanism of demonstration grants, a start has been made in demonstrating the feasibility of upgrading waste management operations through the application of existing technology or the use of new

or improved methods. Approximately 100 demonstration grants have been funded since June 1965.

4. A reasonable foundation has been established for research and development of new and improved processes and unit operations. This has involved in-house, contract and grants activities. Major research efforts include projects for the development of sampling and analytical procedures necessary to characterize solid wastes; detailed technical and economic evaluation of composting processes; and pilot studies in waste volume reduction and small incinerators.
5. The value of regionalization and inter and multi-community approaches has begun to be recognized and demonstrated through the Bureau's demonstration activities. The economies of scale and improved management capabilities have been important concomitant benefits. Additionally, studies have been conducted to emphasize the necessity of detailed data development for system implementation.
6. Important supporting services including a solid waste information system and training programs have been established. The solid waste information and retrieval system now has over 8,000 items in the system available for use by Bureau personnel. Short-term training courses have been designed and presented in all aspects of solid waste management. To date, over 1,000 persons have received at least one of the

offered courses. Ten universities have been awarded training grants to establish graduate level curricula in solid waste management and technology.

7. Significant quantities of technical and management information have been made available to the public in over 300 Bureau publications. The breadth of publications ranges from simple fliers depicting adequate home storage practices to highly technical publications relating to the thermodynamic principles of high temperature incinerators. At this point in time almost 200 publications are in various stages of production. Informational movies have been developed to provide a mechanism for the development of an awareness of solid waste management problems and the proper methods of providing adequate solid waste management.

8. Greater recognition and visibility of the over-all scope and nature of the problem has been achieved on a national scale. Newspaper accounts of this awareness are increasing in almost geometric proportions. In recent months featured articles about solid waste management have been published in many major magazines and newspapers. A "special" on the problems of solid waste management was recently featured on national network television. The local citizen is becoming increasingly aware of the problem.

9. The development of a capability to provide assistance in the engineering and management areas. During FY '69, the Bureau responded to over 600 requests for technical assistance.

D. Future Situation

The program has previously estimated that capital expenditures of about $395 million per year will be required over the next 5 years to obtain a satisfactory level of solid waste management facilities in the U.S. This amount includes neither an estimated $60 million per year to prevent future degradation of solid waste management facilities nor an estimated $300-350 million to adequately support the Federal operating program over the next 5 years. At the present time local governments are financing inadequate facilities at an estimated 25 million annually. This means that currently there is about a 35 million annual deficit in financing construction of required facilities to "hold the line" at a level that is resulting in unsatisfactory solid waste management, e.g., only about 6 percent of sanitary landfill operations are presently satisfactory. Experience and preliminary results from the National Survey being carried out by the States with Federal (Bureau of Solid Waste Management) assistance indicates that local governments are currently unable to maintain existing waste handling facilities with present financial capabilities.

It also has been estimated that a total of $835 million per year for 5 years will be required to upgrade existing collection and disposal practices in this country to a satisfactory level. This total is in addition to the estimated $4.5 billion spent annually for solid waste collection and disposal services. To these figures must also be added each year 4 to 6 percent of the previous year's total expenditure to allow for added costs engendered by population growth and increased per capita generation of solid waste. This additional expenditure represents an increase of approximately 18.5 percent over the present funding level, which is not doing the job.

It is consequently apparent that local governments will find it difficult, if not impossible, to finance improvements or new processes and unit operations developed by the current or future programs of the Bureau. Thus, unless there is adequate fiscal support, the Nation is faced with the dreary prospect of taking one step forward and falling back two in the effort to manage our solid wastes satisfactorily.

The present solid waste management program in the ECA/CPEHS is oriented toward devising a dual approach to solutions for the solid waste problem. The information, planning, and assistance portion of the Bureau is advancing the adoption by communities of existing and emerging technology and upgraded management practices. Concomitantly, the technical and scientific development portion of the program is engaged in validating present technology, extending existing technology, and providing the conceptualization, evaluation, development, and demonstration of innovative solid waste management systems.

During FY 1970 it is estimated that these activities will be responsible for one-third and two-thirds of the program's budget respectively. Continuation of the program under existing legislation is estimated to make little difference to these proportionate expenditures.

While the type and quality of information available for incorporation into planning and assistance programs will increase, the amount of research and demonstration to provide the innovative application of solid waste management techniques will be rather modest.

IV. STRATEGY FOR A CLEANER AMERICA
(Program Priorities and Recommendations)

The major elements of initial strategy in solving the Nation's mounting solid waste management problems evolve logically from the issues enumerated in section II. Very briefly stated they include:

1. Up-grading existing operations both technologically and administratively through increased technical assistance to State, intercommunity and local agencies, and to the maximum extent possible by increased financial support to these agencies
2. Improvement of the solid waste data and information base, emphasizing materials characteristics and effectiveness and deficiencies (technical and administrative) of current systems
3. Expanded and systematized research and development in processes, unit operations and engineered components for handling, reclamation and re-use
4. Development of increased public awareness and understanding of the problems of solid waste management
5. Improved institutional structures and arrangements for coping with solid wastes

6. Expansion and up-grading of industry involvement and participation in this area
7. Control of inputs to solid waste management systems

From a tactical standpoint, i.e., the means by which the strategies are to be carried out, it must be recognized that the management of solid wastes is not a single, unique problem with a single, unique solution. Accordingly, a variety of "tactics" is essential to permit specific system optimization.

The over-all program priorities and recommendations noted rather tersely below characterize the strategy for a cleaner America. The initial tactical approaches are noted in a generalized form. The implementation of these initial tactical approaches will produce the specific "tactics" noted above, in addition to providing feed-back information required to continually up-date and up-grade the over-all program plan. The program priorities and recommendations are:

1. Increasing assistance to States, regions, and local solid waste management activities
    a. In application of existing technology
    b. In demonstrating new and improved processes and unit operations

c. In developing improved administrative management capability and systems

Accomplished by:

a. Money. Increased financial assistance through planning grants, demonstration grants and, increasingly important, construction grants, loan guarantees, revenue sharing, or other viable mechanisms for financing equipment and facilities

b. Upgraded dissemination of technological and administrative information relating to solid waste management operations

c. Increased number and up-graded personnel

2. Improvement of solid waste data and information base

a. On quantities and characteristics of solid wastes from spectrum of generating sources

b. On characteristics and status (effectiveness) of current practice--technical and administrative

c. On costs and financing

d. On manpower and training requirements

e. On legal and administrative aspects

Accomplished by:

a. General and specialized surveys of solid wastes by generating sources
b. Specialized extensions of National Survey
c. Specific short-term and long-term data-gathering and analytical efforts on existing systems

3. Research, development, and testing of solid waste handling processes, unit operations, and engineering components
   a. To develop, on a systematic basis, processes, unit operations and engineered components that will permit technical and economic trade-offs and enable optimization of system design and modification for the variety of local conditions and wastes

   Waste separation processes, unit operations, and components are of first priority concern followed by homogenization processes leading to reduced heterogeneity of wastes and therefore to maximum efficiency of handling, reclamation, and reuse, or disposal

From a public acceptance and requirement for service standpoint, the storage, collection, and transport segments of the matrix flow chart must continue to be emphasized

While processing, including reclamation and reuse, and disposal do not have the public visibility, they must be recognized as integral and important segments of the total system

b. To accelerate application of above to resource recovery, reclamation, and recycle (paper and paper products probably first priority)

c. To maximize mechanization and thereby reduce labor requirements and costs and improve system efficiency

d. To test (demonstrate) under full-scale operating conditions processes, systems, subsystems, and components to validate technical and economic performance

Accomplished by:

a. Development, documentation, and continual updating of comprehensive, detailed, systematic r&d and testing plan, including task and subtask objectives, schedules and time frame, interfaces, and resource requirements. (This document represents guidance for the initial development of such a plan.)

b. Conduct of analytical and evaluative studies to determine viable alternatives and priorities

c. Stimulation of industrial participation in total r&d program

d. Collaborative r&d and testing projects with other Federal agencies (HUD, Agriculture, Interior); State, regional and local agencies; and industry

e. Mission-oriented research grants to qualified universities and nonprofit institutions

f. Adequate budget support of clearly defined and justified in-house programs including contracts

4. Development of improved and new administrative management systems and mechanisms, including institutional structures and arrangements, cost accounting and financing schemes, model legislation and ordinances, and control mechanisms and procedures

   a. To take advantage of modern systems management and operations research techniques
   b. To take advantage of economies of scale
   c. To overcome legal (and political) obstacles to inter-community or regional approaches to the problem
   d. To facilitate financing of capital facilities and operations
   e. To provide proper legislative base for management system development and operation and for regulation and control

Accomplished by:

   a. Conduct of legal, economic, and other management type studies to define feasibility and economics of alternative approaches whether tax supported, regulated investor-owned utility, or other scheme, use of taxes and/or economic incentives for control purposes

   - b. Preparation of criteria, guidelines, procedures, model legislation, regulations, etc.
   - c. Promotion of legislative and administrative action at appropriate levels of government to enable new and improved systems to be put into practice
   - d. Development of comprehensive technological assessments to aid the political decision maker in judging alternatives

5. Improving public awareness of and attitudes toward the management of solid wastes
   - a. To increase user convenience so that community inputs can be upgraded into support of proper solid waste management system
   - b. To reduce generation and improve initial storage of residential solid wastes
   - c. To provide bases for necessary regulation and control

Accomplished by:

   - a. Conduct of psychometric studies and analyses to characterize and modify public reactions and attitudes relative to solid waste management problems

b. Active public affairs programs of Federal, State, and local levels using effective communications mechanisms (TV, radio, news media, etc.) to inform various constituencies (civic groups, schools, professional groups, etc.)

6. Assure adequate, properly trained manpower to manage and operate solid waste management systems

   a. To up-grade "professionalism" in the field

   b. To develop necessary labor force for operations

   c. To up-grade status and working conditions of solid waste worker

Accomplished by:

   a. Conduct of surveys and studies to determine manpower requirements

   b. Conduct of appropriate training programs at Federal, State, and local level

   c. Upgrading of professional educational consideration of problem in college curricula

   d. Working with labor unions

V. BUDGET

A. Operating Budget--Federal Program 1971-1975

The estimated budget support required to attack and accomplish the stated priority tasks is shown at three levels, indicated low, intermediate, and high, respectively, in Tables 1, 2, and 3.

The low estimate represents less than a "hold-the-line" effort in that the over-all program output, i.e., percentage of population being served by adequate solid waste management systems, would probably diminish because of increased waste generation and population increases. While a few needed advances could be accomplished in program priority area 2 (Improvement of the Solid Waste Data and Information Base) and the r&d portion of program priority area 3 plus the other program areas indicated, it is believed that the rate of accomplishment in these areas when compared with the rate of demand for program outputs would necessarily result in an increasingly widening gap. It should be recognized that this low budget will not allow the development of realistic research and demonstration programs. The major program outputs at this level of support would be:

1. Improved knowledge of wastes quantities and characteristics from some (but not all) generating sources, including a small percentage of industrial solid wastes.
2. Improved technologic base for development of new and improved unit operations and components but minimal alternatives and full-scale performance testing.

TABLE 1

FY 71-75 5 Year Plan - Low

In Thousands of Dollars

Reproduced from best available copy.

	70*	71	72	73	74	75
Information, Planning, & Assistance						
Information Resources	385	400	600	700	800	1,000
Planning Assistance						
Direct Operations	40	60	70	80	90	100
Grants	1,500	1,500	1,500	1,500	1,500	1,500
Technical Assistance	288	500	600	700	800	1,000
Training Assistance						
Direct Operations	331	400	450	500	600	700
Grants	490	750	1,000	1,250	1,600	2,100
Construction						
Direct Operations	0	0	0	0	0	0
Grants	0	0	0	0	0	0
Technical & Scientific Development						
Research & Development						
Direct Operations	1,638	2,500	2,750	3,000	3,250	3,500
Grants	2,144	2,500	3,000	3,000	3,000	3,000
Survey & Operational Analysis	500	1,000	1,000	1,000	1,000	1,000
Demonstrations						
Direct Operations	277	500	750	800	850	900
Grants	5,150	6,000	6,500	7,000	7,000	7,000
Program Management						
In-House Management	629	800	1,000	1,200	1,400	1,600
ECA-CPEHS Tap	1,500	2,500	2,750	3,000	3,300	3,500
TOTAL	14,872	19,410	21,970	23,750	25,190	26,900

* For Information purposes only

TABLE 2

FY 71-75 5 Year Plan - Intermediate

In Thousands of Dollars

Reproduced from
best available copy.

	70*	71	72	73	74	75
Information, Planning, & Assistance						
Information Resources	385	750	1,400	2,100	2,300	2,500
Planning Assistance						
Direct Operations	40	100	100	100	100	100
Grants	1,500	5,600	8,000	7,000	6,000	6,000
Technical Assistance	288	1,000	1,500	2,000	2,500	3,000
Training Assistance						
Direct Operations	331	600	800	100	1,500	2,000
Grants	490	750	1,000	1,250	1,600	2,100
Construction						
Direct Operations	0	2,000	3,500	4,000	4,500	5,000
Grants	0	0	35,000	90,000	150,000	200,000
Technical & Scientific Development						
Research & Development						
Direct Operations	1,638	10,000	26,200	27,850	28,250	29,650
Grants	2,144	3,000	3,500	4,000	4,500	5,000
Survey & Operational Analysis	500	1,400	1,500	1,700	1,750	1,750
Demonstrations						
Direct Operations	277	1,000	2,000	4,000	6,000	8,000
Grants	5,150	8,000	4,000	1,500	1,500	1,500
Program Management						
In-House Management	629	2,300	2,500	2,500	2,500	2,500
ECA-CPEHS Tap	1,500	2,500	5,000	5,000	5,000	5,000
TOTAL	14,872	39,000	96,000	154,000	218,000	274,100

* For Information purposes only

TABLE 3

FY 71-75 5 Year Plan - High

In Thousands of Dollars

Reproduced from best available copy.

	70*	71	72	73	74	75
Information, Planning, & Assistance						
Information Resources	385	1,000	2,000	3,000	4,000	5,000
Planning Assistance						
Direct Operations	40	200	200	200	200	200
Grants	1,500	8,000	12,000	10,000	10,000	10,000
Technical Assistance	288	2,000	4,000	6,000	8,000	10,000
Training Assistance						
Direct Operations	331	600	800	1,000	1,500	2,000
Grants	490	750	1,000	1,250	1,600	2,100
Construction						
Direct Operations	0	5,000	5,500	6,000	6,500	7,000
Grants	0	50,000	100,000	200,000	300,000	500,000
Technical & Scientific Development						
Research & Development						
Direct Operations	1,638	33,450	45,000	65,550	82,200	96,900
Grants	2,141	5,000	6,000	7,000	8,000	9,000
Survey & Operational Analysis	500	2,000	2,500	3,000	4,000	5,000
Demonstrations						
Direct Operations	277	1,000	2,000	4,000	6,000	8,000
Grants	5,150	8,000	4,000	3,000	3,000	3,000
Program Management						
In-House Management	629	3,000	5,000	5,000	5,000	5,000
ECA-CPEHS Tap	1,500	5,000	10,000	10,000	10,000	10,000
TOTAL	14,872	125,000	200,000	325,000	450,000	675,000

* For Information purposes only

6/6/69

The high estimate relates to a "catch-up and keep-up" program wherein major progress would be made in increasing the percentage of the population served by adequate solid waste management systems and continually decreasing the gap between requirements and capabilities so that in say, hopefully, 10 years the gap would be closed and adequate solid waste management systems would be serving perhaps 90 percent of the population.

The intermediate estimate represents a reasonably balanced program in which the ultimate program outputs are extended over a long period, say 20-25 years. The gap between requirements and capabilities, although decreasing at a slower rate, at least would not be widening. Reasonable progress and accomplishment in all parts of the program would be expected. The major program outputs over the 5-year period would be:

1. The development of an adequate technical information and data base
2. A developed and tested technological base to permit optimum system design, including reclamation and reuse in limited specific areas (paper, nonferrous metals).
3. A significant improvement in certain specific segments of the matrix flow chart, e.g., the percentage of satisfactory sanitary landfills would be increased from the presently estimated 6 percent to perhaps 50-60 percent

4. The development of guidelines, procedures, model legislation, and other administrative bases to provide improved administrative management schemes at the State, regional, and local levels

B. Support for Capital Facilities

As previously noted, there is a need to explore alternative approaches for making available the presently estimated $2.5 billion total required over the next 10 years to capitalize required solid waste management facilities in the Nation. In the absence of definitive studies on these alternatives (grants, loan guarantees, etc.) and recognizing the lead times involved in gearing-up such a construction program, the following construction grants tabulation is noted only as an indication of requirements. These estimates are based on a 50-50 funding assumption.

TABLE 4

Estimated Construction Grant Fund Requirements

Year	Funds (Millions)
'71	--
'72	35
'73	90
'74	150
'75	200

C. Resource Requirements

The relation of the nation's solid waste problem to the Gross National Product appears to be a reasonable basis for correlation of effluence and affluence. The Gross National Product for 1967 was 785.1 billion dollars. During the same period of time the 1968 national survey of solid waste practices* indicates that private and public solid waste management costs were 4.5 billion dollars. If this ratio of expenditure to Gross National Product is consistent, it may be predicted that these expenditures will be greater than 7 billion dollars in 1975. (See the tabulation below.) These figures do not include expenditures by industry or the Federal government.

Year	Gross National Product	Solid Waste Management Expenditures
1967	785.1 billion dollars	4.52 billion dollars
*1970	935	5.35
*1975	1258	7.21

*Estimates of Gross National Product from U.S. Congress Joint Economic Committee; U.S. Growth to 1975: Potentials and Problems.

The estimates of program needs in the intermediate budget (not including construction grants) are based on a conservative 1 percent of the estimated national expenditure for solid waste management for the years indicated. While 1 percent would appear to be a minimum expenditure, the industrial sector is pursuing some research and development projects which will also contribute to the total problem solution. These additional industry activities will provide a total effort of an estimated 1 1/2 percent of the expenditure.

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*An Interim Report - 1978 National Survey of Solid Waste Practices

Year	1 Percent of Estimated Solid Waste Expenditure
1971	57,000,000
1972	61,000,000
1973	65,000,000
1974	68,000,000
1975	72,000,000

VI. MANAGEMENT OF THE FEDERAL PROGRAM

A. Requirements for Federal Legislation

An obvious requirement for implementation of the national program envisioned in this document is extension of current authorizing legislation beyond its present expiration date of June 1970. This required extension must increase the current ceiling of $20 million and also should provide for support of local and regional planning and systems development and construction of capital facilities. The need for coordination of local, intercommunity and regional planning in the solid waste area with that carried out for other environmental control programs should be clearly delineated. The intermediate budget shown in Table 2 anticipates the passage of such legislation and the provision of additional manpower.

B. CPEHS/ECA Solid Waste Management Program Needs

1. There is an urgent and growing requirement to upgrade and augment the existing technical management and planning capabilities within the CPEHS/ECA Bureau of Solid Waste Management. The application, on a much more extensive and intensive basis, of modern systems analysis and planning and evaluation techniques to the over-all program is a top priority requirement to enable the advancement of a balanced program on the basis of clearly defined, specific objectives and well documented, detailed program plans.
2. To facilitate and expedite the above, prompt consideration should be given to the use of technical

program management assistance contracts. The effectiveness of such instruments has been amply demonstrated by NASA and AEC and are particularly suited to the character and needs of the Bureau of Solid Waste Management program.

3. Increased participation and involvement of technical programs staff in grants activities to maximize the relevance and effectiveness of these activities in relation to mission requirements is necessary. Although useful steps have been taken in this regard, further upgrading is required in order to significantly sharpen the focus of all available resources on priority needs. There should be no implication of any lack of interest or concern in university based research in this statement. This will involve technical program staff participation in grants "programming" and cognizance of grants projects progress and output.
4. Assuming that some form of Federal support for construction of State, intercommunity, and local capital facilities will be forthcoming, a need for a capability to review facilities plans and specifications, conduct economic analyses, and provide necessary management over-view must be anticipated. The amount and kind of resources required to meet this need as well as the timing and scheduling of its availability must be developed.

C. Requirements at Administration, Service and Departmental Levels

1. In order for the CPEHS/ECA Solid Wastes Program to be effective in solving the solid waste management problems of the nation, it is essential that strong support be forthcoming up through the Department in terms of needed legislation and the agency's leadership role and responsibilities in this area. The management of solid wastes must be recognized as a priority national environmental problem.
2. The carrying out of activities related to the States, intercommunity and local governments on a decentralized regional basis has some distinct advantages in terms of effective recognition of the details of local problems. However, great care must be taken to assure that the program capabilities are not so fragmented or diffused so as to be detrimental to the over-all effecitve use of the resources allocated to the total program.

D. Federal Agency Interfaces and Coordination

1. As previously noted, under the Solid Waste Disposal Act--P.L. 82-272, DHEW (ECA-Bureau of Solid Waste Management) is assigned the major responsibility in this area. It is clear that this responsibility must include a "lead agency" role in dealing with other Federal agencies having direct, legitimate interests and concerns in this field as noted in Section II.

Generally speaking, there is a need to establish effective, continuing working relationships with all of these agencies to assure that areas of mutual interest and concern are adequately handled. While significant specific efforts have been made in this regard, it is apparent that such an effort must be mounted on a more systematic, deliberate basis.

2. There is a need, in relation to each of the Federal agencies, for program staff representatives to specifically delineate the interfaces or interface areas, then to develop mechanisms whereby these interfaces can be managed, primarily at the working program level. To the extent that the delineation of the interface and interface management mechanism indicates the desirability or necessity for formalized interagency agreements, these should be developed and consummated.

3. The major agency interface situations are:

    a. HUD--Because of the nature of, and priorities assigned to the urban problems, it is clear that an extensive strong interface with HUD exists. Although initial staff interagency disucssions have been held to delineate these interfaces, more work has yet to be done to accomplish this and to establish mechanisms for managing these interfaces.

It is contemplated that collaborative projects would evolve, particularly in the demonstration of new sub-systems, processes and unit operations in connection with urban redevelopment and renewal programs, and housing development programs. It is estimated that an initial interface delineation and management plan will be completed in 3-6 months.

b. USDA--The major area of interface with Agriculture is in delineating areas of solid waste responsibility and in assuring that respective Agency resources are utilized in an optimal manner. Interagency staff discussions have been initiated to accomplish this.

c. Interior--As previously noted, the interface with DI has been established and is functioning smoothly. In the future, joint efforts could produce considerable return for the dollar invested. Examples of joint project efforts might be a comprehensive management system for the abandoned and junked automobile utilizing the community relation expertise of BSWM and the mineral science capability of the Bureau of Mines. Relationship with the Federal Water Pollution Control Agency in areas of mutual interest are progressing satisfactorily.

   d. Within HEW-CPEHS a close working relationship with NAPCA exists with respect to the incinerator-combustion-air pollution interface. Work coordination efforts are under way.

4. Working relationships with other Federal agencies in assisting them in connection with specific solid waste management problems have developed. Examples of such assistance activities include:
   - a. TVA--Disposal of fly ash
   - b. Forest Service--Solid waste management in connection with recreational use of F.S. lands
   - c. DOD--Technical assistance in resolving unique problems
   - d. Bureau of Land Management--Criteria and consultation for use of land for disposal purposes
5. Other interfaces of a specific nature remain to be developed with the Department of Labor with respect to the solid waste worker, with DOT in relation to transport problems, and the Department of Commerce
6. The establishment of an interdepartmental committee at the working level with the CPEHS/ECA Solid Wastes Program representative as chairman, merits consideration as a coordinating mechanism. A group recently established through OST to consider DOD inputs into domestic problems (including solid wastes) might serve as the precursor for such a committee.

PART II

SOLID WASTE PROBLEM STATEMENTS

PART II
SOLID WASTE PROBLEM
STATEMENTS

General Statement

The interfaces in solid waste management are both broad in certain selected areas and in other areas non-existent. This problem statement discusses the problems of solid waste management by the flow characteristics of a solid waste management matrix, i.e. generation, storage, collection, transport, processing and disposal while emphasizing the specific waste streams that eminate from the various waste generations i.e., residential, commercial, industrial, agricultural, and institutional. Coupled with the discussions of the "hard" problems is a discussion of the "soft" problems of overall management.

Much of the problem statement is based on intuitive and judgmental reasoning due to the total lack of basic scientific information related to the various aspects of solid waste management. The fact that the problem statement is both objective and subjective dramatically illustrates the poor condition of solid waste management in the United States today. Where fact exists, it is provided; where fact is assumed to be fiction, it is identified; and where neither fact nor fiction exists, one can only postulate the enormity of the problem.

It is sufficient to say that the costs of solid waste management may equal 1% of the GNP, that it utilizes over 500,000 men per year, and affects every aspect of America's society to illustrate the interface that solid waste management has with the total natural environment. Problems must be clearly defined and identified, costs must be attached to solutions of those problems, priorities of solution must be established, and adequate and proper support provided at all levels of the government and private sectors to effectively solve the existent problems and the new emerging problems.

Solid Waste Problem Statements

A. Generation

A.1. Residential Solid Wastes

Residential solid wastes are defined as those solid wastes generated and discharged from single family and multifamily dwellings and included both wastes generated from within the dwelling and from the yard and activities outside the dwelling.

Fluctuations in the quantity and quality of residential solid waste generated occur both daily and seasonally. In most systems, these variations increase to some extent after weekends and holidays. Seasonal variations in the generative characteristics may be large and may differ greatly from city to city. This fact stems from geographical variations in length of growing season, type of vegetation grown in the area, and the overall amount of inclement weather which affects collection practices, and the economic-social characteristics of the generation zone.

A.1.1. Quantity

Although studies have been conducted to determine the quantity of residential solid waste produced on a per capita basis, the results have not shown a high degree of correlation between studies. Generation rates up to 7 pounds per person have been postulated and this type of data is of little use to someone attempting to design a solid waste management system. Such general statements as "900 million pounds of solid waste are generated each day in this country" does not help the public works official provide the basic data required for sound system design and management.

Since one of the purposes of the Solid Waste Disposal Act is to help develop "new and improved methods of proper and economic solid waste disposal," it is essential that data concerning the residential solid waste generation rates be developed to provide the necessary foundation for planning, design, and systems development.

A.1.2. Quality

Residential wastes consist of paper, plastics, metals, cloth, wood, food wastes, and numerous materials. A number of studies conducted by BSWM* in various areas around the country indicate that there is no "standard" composition. Table I provides the results of these studies and indicates the variance in composition.

Due to its heterogeneous nature, the specific properties of residential solid waste are extremely hard to characterize. Identically sized samples taken from the same lot will have different makeups. Other physical factors which affect the design and operation of a waste management system such as density, heat value, compressibility, and moisture content also vary radically.

In order to develop better solid waste management systems, much additional information is needed concerning the physical and chemical parameters of residential solid wastes. Such

*Bureau of Solid Waste Management in the Consumer Protection and Environmental Health Service/Environmental Control Administration

Table I

Composition of Residential Solid Waste

% By Weight (As Received)

	Food Wastes	Textiles	Paper Products	Plastics	Leather, Rubber	Yard Wastes	Wood	Glass & Ceramics	Metal	Brick, Rock, Dirt, Etc.
Johnson City, Tennessee 10/67	26.1	1.4	45	1.7	1.0	1.6	.4	11	10.9	1.0
Cincinnati, Ohio 10/66	28	1.4	42	1.6	---	6.4	2-7	7.5	8.7	---
Memphis, Tennessee 7/68	19.7	4.8	29.8	-----3.0----		12.1	1.7	9.8	6.6	12.5
Flint, Michigan 6/67	29.1	.3	13	-----1.9----		26.7	1.0	12.7	19.5	0

Source: Division of Technical Operations
Bureau of Solid Waste Management

[redacted] [redacted]CA/[redacted]S [redacted] information is required for the development and design of equipment and unit operations for the entire solid waste management flowsheet. For example: the efficiency of storage and collection vehicles depends upon the density and compactibility of the solid waste involved; the capacity of a sanitary landfill depends directly on the compactibility of the solid waste; and the heat value of solid waste is the basic factor in the design of incinerators.

The trend today is towards the production and use of more throw-away articles made of paper and plastic; and consequently, the makeup of residential solid wastes in the future will reflect this trend. Much more packaging will be consumed in the next decade than in the previous one. There will be more kinds of packages on the market and packages will be composed of a vast variety of materials.

The increased use of home food waste grinders could radically affect storage and collection practices by reducing the amount of organic wastes entering the solid waste management system.

These relationships and trends dictate the need for adequate basic data on the quality characteristics of residential solid waste and for a system that will monitor these relationships to reflect changes, etc. in the future. We cannot be using equipment and methods which were designed for yesterday's solid waste and expect the solutions to today's problems to naturally evolve.

A.2. Commercial Solid Waste

Commercial solid wastes are defined as those solid wastes generated and discharged from a wide variety of activities that can be categorized as retail, wholesale and service establishments.

Commercial enterprises can be typified in that they are engaged in the sale of good and services. Examples of these establishments include department, food, home furnishings, drug, hardware, appliance repair stores, amusement and recreational facilities, hotels and lodging places, restaurants, commercial office buildings, etc.

The commercial enterprises included in this discussion, as described by the BOB Standard Industrial Classification Manual (SIC), are tabulated in Table 2.

The data that is available has been gathered with respect to collected quantities and is not easily related to the amount actually generated by specific commercial enterprises. Data indicates that approximately 45% of commercial establishments conduct some degree of on-site processing and volume reduction, i.e. incinerators, grinders, open burning, etc. Information of this type clearly indicates the need for definition of the quantitative and qualitative characteristics of commercial solid wastes. The nature and extent of the impact of commercial solid wastes to the total solid waste management system is unknown.

Table 2

Commercial Enterprises

SIC Division	Type	Major SIC Group
Division F. Wholesale and retail trade:		
	Wholesale trade	Major Group 50.
	Building materials, hardware, and farm equipment dealers	Major Group 52.
	Retail trade--general merchandise	Major Group 53.
	Food stores	Major Group 54.
	Automotive dealers and gasoline service stations	Major Group 55.
	Apparel and accessory stores	Major Group 56.
	Furniture, home furnishings, and equipment stores	Major Group 57.
	Eating and drinking places	Major Group 58.
	Miscellaneous retail stores	Major Group 59.
Division G. Finance, insurance, and real estate:		
	Banking	Major Group 60.
	Credit agencies other than banks	Major Group 61.
	Security and commodity brokers, dealers, exchanges, and services	Major Group 62.
	Insurance carriers	Major Group 63.
	Insurance agents, brokers and service	Major Group 64.
	Real estate	Major Group 65.
	Combinations of real estate, insurance, loans, law offices	Major Group 66.
	Holding and other investment companies	Major Group 67.
Division H. Services:		
	Hotels, rooming houses, camps, and other lodging places	Major Group 70.
	Personal services	Major Group 72.
	Miscellaneous business services	Major Group 73.
	Automobile repair, automobile services, and garages	Major Group 75.
	Miscellaneous repair services	Major Group 76.

SIC Division	Type	Major SIC Group
Division H. services con't.:		
	Motion picutres	Major Group 78.
	Amusement and recreation services, except motion pictures	Major Group 79.
	Legal services	Major Group 81.
	Educational services	Major Group 82.
	Museums, art galleries, botanical and zoological gardens	Major Group 84.
	Nonprofit membership organizations	Major Group 86.
	Miscellaneous services	Major Group 89.

A.2.1. Quantity

Commercial solid waste collected are estimated to range between 1-2 lbs/cap/day, based on available data. Applying this estimated collection rate to the national population (200,000,000) indicates that some 1,500,000 tons/day of commercial solid waste may be collected daily. This may represent only one half the amount produced because of source reduction practices of some commercial enterprises. Data is not available to accurately provide the actual amount of total commercial solid waste generated or the amounts generated by each commercial enterprise on either a gross or per capita basis.

Information on generated or collected quantities for individual enterprises is not available. This prevents establishing the interrelationships, if any, between quantities produced by different commercial enterprises, or the amounts generated from different activities within a single commercial enterprise.

A general lack of knowledge exists on the manner in which wastes are generated, the factors which influence the quantities produced, and the manner in which waste generation can be reduced.

The gross lack of various types of quantitative data prevents systematic planning and implementation of storage, collection, transport, processing and disposal requirements for commercial solid wastes.

A.2.2. Quality

Commercial solid waste characteristics are as ill-defined as quantities. Few, if any, studies indicate the characteristics either by total commercial category or by individual enterprises. A general impression provides an estimate that paper is a substantial portion of the total amount for many commercial enterprises. However, other activities such as restaurants and produce markets generate relatively high organic wastes. There is no data to indicate what the composition is for various commercial enterprises or for the total commercial sector. Without this basic data reclamation, reuse and market potential studies cannot be initiated. Efficiently designed storage, collection, transport, processing and disposal subsystems require description to meet the needs that may be dictated by specific characteristics of commercial solid wastes.

A.3. Industrial Solid Wastes

The common solid waste generated by our society and our current processing methods are quite obvious to all - the open and sometimes burning dump, the incinerator, the side-of-the-road promiscuous dump, the acres of junk automobiles and the well operated sanitary landfill - all these are relatable to our living habits. A relatively unknown and underacknowledged solid waste problem is the by-products and residue of our industries. All too often, industrial solid wastes[1] are piled on the back lot, acres of sludges are lagooned, drums of off-grade products and hazardous materials are stored in warehouses, potentially dangerous slag mountains are formed, bales of paper, metals, textiles, plastics, etc. are piled high awaiting favorable markets or just waiting for a needed treatment or disposal process. There is virtually no end to the different types and quantities of industrial solid waste generated and they are as different as the industries producing them. Further, they change in characteristics and amounts as our industries develop new processes and products. Yet our knowledge of those wastes is almost non-existent. What little we know is basically intuitive and is not based on sound basic data and scientific fact. If we are to fulfill our commitment to the American people to protect the quality of their environment, knowledge of industrial solid waste must be developed and where needed new technology provided to adequately manage these wastes.

We are assuming that similarities exist in certain solid wastes generated by the different industrial groups. The solid wastes from a paper mill in Oregon no doubt has characteristics similar to solid wastes produced by a paper mill using a like process in Georgia. This similarity, with inevitable minor

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[1] By definition, industrial solid wastes are any discarded solid materials resulting from an industrial operation or deriving from an industrial establishment. They include processing, general plant, packaging and shipping, office and cafeteria wastes. Specifically excluded are dissolved solids in domestic sewage and any dissolved or suspended solids in industrial waste waters.

differences in characteristics between solid waste generators, will permit a management plan to be developed for each of the industrial groups in the United States.

The solid wastes generated are related to the industry and therefore each industry must be understood to allow for development of the management plan. No single problem exists which has a single, simple solution. Therefore, different solid waste management systems will most likely be required for the different types of solid wastes generated.

The discussions related to this sector of the plan will consider industrial solid wastes by the industry generator, insofar as possible, defined by the SIC Manual[2] of the Bureau of the Budget (See Table 3).

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[2] SIC - Standard Industrial Classification, Bureau of the Budget

Table 3

STANDARD INDUSTRIAL CLASSIFICATION GROUPS

(Construction & Manufacturing)

Major Group Number	
15	Building Construction - general contractors
16	Construction other than building construction - general contractors
17	Construction - special trade contractors (includes wrecking and demolition)
19	Ordnance and accessories
20	Food and kindred products
21	Tobacco manufacturers
22	Textile mill products
23	Apparel and other finished products made from fabrics and similar material
24	Lumber and wood products, except furniture
25	Furniture and fixtures
26	Paper and allied products
27	Printing, publishing and allied industries
28	Chemicals and allied products
29	Petroleum refining and related industries
30	Rubber and miscellaneous plastic products
31	Leather and leather products
32	Stone, clay, glass and concrete products

33	Primary metal industries
34	Fabricated metal products, except ordnance, machinery, and transportation equipment
35	Machinery, except electrical
36	Electrical machinery, equipment and supplies
37	Transportation equipment
38	Professional, scientific and controlling instruments; photographic and optical goods; watches and clocks
39	Miscellaneous manufacturing industries

A.3.1. Quantity

The Bureau of Solid Waste Management estimates that 110 million tons of various industrial solid wastes types are generated annually in the United States (See Table 4 for selected generative data). This estimated 110 million tons is approximately 30 percent of all wastes generated in the nation. Table 5 estimates the major industrial solid waste generated. However, these estimates provide little definitive information on the total amounts of solid wastes generated by the different SIC industries, where these wastes originate within intricate industrial processes; their potential increases; and whether the waste material generated is being recycled, reused in another process, or discharged. A general study conducted for the BSWM by contract determined that industrial solid waste generation would increase by 30 percent from 1965-1975.

Worthwhile and needed information about industrial solid wastes is difficult to obtain because of the proprietary nature of the processes producing the wastes. It is desirable to know process details to permit adequate evaluation of the amounts and types generated and determination of potential reuse, etc.

Work is needed to identify and define the amounts of solid waste generated by each process on a common parameter; and to determine the amounts and types of solid wastes being recycled on-site, reused, reclaimed or disposed. Such information will be valuable for needed research and development of new or improved waste processing and disposal techniques; will provide basic data to assess the impact of industrial solid wastes upon present solid waste management systems; will indicate those areas requiring special handling, processing and disposal methods; will enable the development of valid projections to be made for the quantities and types of solid waste to be expected; provide in the future the basis for the development of future comprehensive solid waste management systems; and stimulate the upgrading of existing industrial solid waste management systems through the application of known technology.

Table 4

ESTIMATED INDUSTRIAL SOLID WASTE GENERATED PER YEAR IN SELECTED INDUSTRIES

1965

SIC Code		Estimated Tons Per Year
19	Ordnance and Accessories	355
20	Food and Kindred Products	7,200
21	Tobacco Manufacturers	400
22	Textile Mill Products	1,100
23	Apparel	360
24	Lumber and Wood Products, Except Furniture	38,000
25	Furniture and Fixtures	2,000
26	Paper and Allied Products	5,000
27	Printing, Publishing, Allied Industries	7,600
28	Chemicals and Allied Products	3,000
29	Petroleum Refining and Related Industries	550
30	Rubber and Miscellaneous Plastic Products	2,500
31	Leather and Leather Products	3,150
32	Stone, Clay, Glass and Concrete	2,500
33	Primary Metal Industries	1,750
34, 35	Fabricated Metal Products and Machinery	3,850
36	Electrical Machinery, Equipment, Supplies	1,500
37	Transportation Equipment	1,750
38	Instruments, Photographic and Optical Goods	850
39	Miscellaneous	850

Table 5

RANKING OF INDUSTRY BY QUANTITY OF SOLID WASTE GENERATED

1. Lumber and Wood Products
2. Printing and Publishing
3. Food and Kindred Products
4. Paper
5. Fabricated Metal Products
6. Leather
7. Chemical
8. Rubber

A.3.2. Quality

Two categories of solid wastes are generated by industry: (1) wastes that are peculiar to the individual industry by reason of the nature of the raw material processed and the products produced; (2) wastes that are common to all types of industry.

As an example, the ordnance industry produces solid wastes that are peculiar to that industry alone and the wastes oftentimes, pose difficult and hazardous processing/disposal problems. It is not always feasible or desirable to dump off-specification or decomposed munitions in the oceans. The qualities of this particular solid waste may prohibit common transportation or disposal techniques. The textile industry, fabrics and rugs, has undergone vast changes in recent years by the introduction of synthetic materials. The various synthetic scraps are not amenable to satisfactory incineration; they do not compact in sanitary landfills. In short, the textile industry, through improved product technology, has created a new and difficult solid waste problem. No consideration was made, during the product development, regarding either the quantity or the quality of the resultant solid waste.

Other examples can be cited for each SIC manufacturer. Some industrial solid wastes are low in volume or weight, but pose difficult disposal problems because of the quality, usually hazardous or toxic.

Other industrial wastes become solid wastes management problems because they cannot be taken into other waste receiving streams. Examples of such wastes generated by specific industries are residues from planting, pickling, painting, and similar operations. For the most part these processes produce liquid residues that are handled separately from the solid wastes but disposed of in solid wastes facilities. Nevertheless, oils, paints, dyes, plating and pickling liquors, solvents, and adhesives do appear in such solid wastes as metal cuttings, sawdust, paper, wood, cloth, and junk. Without adding to the amount of wastes to be managed, they create certain problems related to the method of disposal; hence their presence is noted in the list of industrial solid waste materials.

Those solid wastes common to many industries include wood, fiber, paper, metal, and plastic containers in which raw materials and supplies for maintenance and operation are received by the industry; scraps of metal, wood, paper, and plastics used by the industry in painting, crating, or otherwise preparing its product for shipment. The normal debris from general housekeeping, operating and maintaining an industrial plant which produces such items as wastepaper, floor sweepings, broken wooden pads, rubber tires, broken glass, and the junk of obsolescence or breakage of equipment. Residues of paint, industrial chemicals, dyes, adhesives, and solvents remaining in discarded containers are also common to all industries, although the amount and kind varies from industry to industry and from plant to plant.

There exists a complete paucity of data and knowledge related to the quality of industrial solid waste generated due to the proprietary nature of much of the information concerning solid waste production. Such lack of knowledge hinders the development of comprehensive solid waste management systems; creates areas of sensitivity in the interface between government and industry; prevents adequate planning for the treatment and disposal of new and frequently more complex wastes; and does not provide the needed input to develop methods of reuse, recycling or reclamation and more importantly waste source reduction.

Studies are needed to develop separation and analytical methods to adequately describe industrial solid waste; to identify and define the quality characteristics of the SIC generated waste; the possibly degrading effect on the environment; the potential of real health hazards; the potential of combining difficult or dangerous-to-handle wastes, e.g. acids and bases to neutrality. The data developed by such studies will provide insight into areas requiring specific hardware development for control or source reduction; new areas for industrial exploitation; the feasibility of regionalization of solid waste management systems; and the needed programs for adequate industrial operational techniques to properly manage these wastes.

A.4 Agricultural Solid Waste

Agricultural wastes originate from animal, poultry, crop and forest product growing and harvesting. They include such diverse materials as animal and poultry manures, field harvesting debris, vineyard and orchard prunings, animal carcasses and used pesticide containers.

The delineation between agricultural and industrial waste is often confusing. Waste originating from industrial processing of agricultural products, e.g. food canning, meat packing, etc., are sometimes considered as agricultural wastes and other times as industrial wastes. This confusion often leads to large segments of the society producing solid wastes not being fully and adequately considered the responsibility of any specific organization unit within the Federal program. A firm distinction and definition of each waste type is therefore desirable. For the purpose of this report, the following definition has been used.

> "Agricultural solid wastes are those wastes resulting from the growing, tending and primary harvesting of crop, forest, animal and poultry products. The major categories are animal and poultry manure; crop and forest residue; and waste pesticide and pesticide containers. Once the raw materials are placed in the processing stream, the wastes generated are considered industrial wastes."

A.4.1. Quantity

Accurate quantity data are not generally available, but it has been grossly estimated that the annual production of livestock and poultry manure may be as high as 50 billion cubic feet or 2 billion tons. Used bedding and dead carcasses contribute to this total. Major crop wastes are similarly estimated to be in the magnitude of 550 million tons, while some 25 million tons of logging debris are left annually in wooded areas.

The distribution of agricultural wastes further complicates the associated problems in that much of it tends to be concentrated at point locations at or near the urban-rural interface--close to the large population centers rather than widely dispersed in the rural setting. As much as 50 percent of animal wastes are generated in the confined growing operations near urban centers. Confinement growing and production is firmly established in the beef, dairy, poultry and swine industries and can be expected to continue. These centralized and automated operations are designed to provide more and better products but also produce proportionately greater amounts of wastes. In the foreseeable future, the amount of waste per unit of production will not be decreased. Further, with larger populations to be fed, the total generation of wastes can only increase. The major problems at the generation site are concerned with odors, dust, and the reproduction of flies and other vectors.

With the increasing mechnization of the harvesting and sorting of field and orchard crops, greater amounts of crop wastes are being left at the source. Concurrently, more culls and waste parts are being transported to centrally located sorting and field packing stations. In effect, this causes an increase in the proportion of waste-to-product and creates handling problems where they did not before exist. Little or nothing is known about the volume, numbers and distribution of pesticide containers. However, it has been estimated that several million containers are used annually. In 1964, 470 million pounds of insecticides were used on 93 million acres of land.

A.4.2. Quality

Most of agricultural waste is highly organic in nature and as such is unstable and subject to rapid decay and putrefaction with the accompanying production of odors, breeding of insect pests and vectors. However, on the other hand, much of the waste from sub-sources is quite homogeneous in nature--a factor which may foster some utilization process. Not enough is known at this time about the specific characteristics of these various wastes to develop utilization approaches. In the same vein, little is known about the optimum situation for odor production and insect breeding. The BOD of animal waste is extremely high. It contains appreciable nitrogen as well as organisms pathogenic to people, animals, plants and poultry. These agents can be dispersed into our surface and ground waters and our air environment if the wastes are not properly managed. More and better information is needed about these quality factors.

In the area of pesticide containers, literally hundreds of formulations are used in various aspects of agriculture with few records of the distribution of the containers or the amount and type of discarded material they contain. An inventory of this type of information is needed.

A.5. Institutional Solid Wastes

Institutional solid wastes are defined as those wastes discharged by institutional activities as classified into nine categories:

1. Hospitals
2. Schools, colleges, and universities
3. Prisons and other penal institutions - including mental hospitals and nursing homes.
4. Military bases and administrative facilities.
5. Military research & development and manufacturing facilities. (arsenals, Dugway, etc.)
6. Governmental administrative facilities (City hall, Capitol, etc.)
7. Governmental utilities or manufacturing facilities. NASA, TVA, AEC)
8. Laboratory and research & development facilities.
9. Recreational (non-profit) facilities. (parks, beaches, libraries)

A.5.1.-A.5.2. Quantity & Quality

The quantity of solid waste generated by institutions in this country is difficult to estimate. Federal agencies alone, both military and civilian, generate approximately 43 million tons of solid waste a year. An estimate of the total amount of solid waste generated by other institutions (schools, hospitals, and prisons) is not readily available.

In hospitals, the average generation is roughly 7-1/2 pounds per patient per day. The increased use of disposable hospital items is raising this figure at a rapid rate. In efforts to eliminate cross infections and reduce mounting operational costs, intensive care hospitals have sparked the development and manufacture of single service items for patient care. Present hospital catalogues list over 300 such single service items, ranging from the "disposable" needle and syringe packs, to paper souffle cups for food service, to scrim examining gowns and bedsheets. Since many of these hospitals were built before the advent of such single service items, present solid waste handling facilities are inadequate to the present demands.

Available data are insufficient to evaluate quantities and characteristics of solid wastes generated at academic or trade schools, colleges, universities, or affiliated research institutes. However, it is possible to infer, for example, that greater than average amounts of radioactive or oily wastes come from medical research centers or auto mechanic schools. Wastes from institutions are normally included as an unidentifiable fraction of municipal wastes. Available data on solid wastes generated by mental hospitals, penal institutions, and nursing homes are scarce. However, such institutions are characterized by long term populations that have little opportunity or income to acquire and use consumer goods. Mass feeding is also characterized by the generation of lesser per capita quantities of food packaging wastes. The types and amounts of military and military-industrial wastes are not generally known outside the Department of Defense. They are, however, presumed very similar to residential or commercial wastes. Nevertheless, some special wastes are associated with defense operations such as waste munitions.

The wastes associated with government administrative facilities are essentially all paper. There is the horrendous prospect of the acceptance of a new, non-destructible paper, (e.g. like that being developed by Dynatech under a NASA contract after the Apollo fire in December 1967). At present we have incomplete information on the generation and separation for salvage of paper wastes within the various levels of government. Information on the amount of wastes transported by 4th class mail is an unknown.

Federal utilities or manufacturing agencies are defined as those which conduct industrial operations such as TVA, AEC or Bureau of Reclamation, in which a product rather than a service is the primary output. These facilities, which may include "company towns", are not subject to State or local control and are accordingly in a unique classification. In this category there is insufficient information on solid waste generation and other features such as handling, processing, disposal, costs and control on which to plan an adequate Federal program of solid waste management.

AEC installations also generate products and wastes whose quantities and characteristics are related to national security. Management of AEC wastes has been of a high caliber, and unclassified inventory data needed for Bureau of Solid Waste Management purposes is readily available.

Visitors to Federal, State, local or other non-profit parks, beaches, libraries, museums, zoological or botanical gardens, and monuments produce solid wastes. Commercial activities ranging in size from one night carnivals to Disneyland (whose associated problems are inversely proportional to their size) are included in another section. The demand for and utilization of recreational facilities is increasing geometrically and there is a critical need for an early assessment of present generation characteristics as well as the practices and problems associated with solid waste disposal at these installations.

As a first approximation, it is often assumed that solid wastes from military bases and administrative facilites are similar to those from municipalities of comparable size. However, there are some important distinctions of presently unknown magnitude which almost certainly cause an important impact upon the environment and which invariably require special handling and processing. These distinctions include the proportion of out-dated explosives or munitions generated in the wastes and the necessity of disposing of classified documents and material; there is a need to qualitatively and quantitatively assess the effect of these differences.

The generation of solid wastes at laboratory and research and development facilities includes a broad spectrum of Federal installations ranging from small laboratories at field sites to the AEC's National Laboratories, State laboratories as well as some private facilities as large as Battelle Memorial Institute. Some of the facilities are closely related to universities. Generally, their solid wastes are highly variable and, except possibly on a large scale, unpredictable in both quantity and quality. From time to time, practically full containers of reagents are disposed of along with other solid wastes (This characteristic is shared with educational institution laboratories); some materials may be toxic, flammable or explosive; and the identity of specific materials is frequently lost. In summary, little is known about the identity and quantity of these materials.

B. Storage

B.1 Residential Solid Waste

Although the composition of residential solid waste has changed greatly, the storage subsystems for these wastes has changed very little in the last fifty years. The cylindrical metal can is still the most popular residential solid waste container. Receptacles of all kinds have been used such as: boxes, lard cans, oil drums, and sacks. In many instances no container is used at all.

Requirements for home refuse storage containers dictate that they be: watertight, have tight-fitting covers, be rodent and fly proof, be easily cleaned, as well as being easy to handle and empty. The thirty gallon galvanized metal can meets these requirements. Plastic cans have been used and are easy to handle due to their light weight. Paper or plastic bag storage is becoming more and more popular.

When concentrations of solid waste become large such as in apartment buildings, large bulk metal containers are used. These containers are mechanically handled and offer a more economical system than individual manually emptied cans.

The type of storage container depends to a great extent on the type of collection system. Special precautions should be made to avoid overweight containers, dangerous liquids and other conditions hazardous to collectors, yet collection personnel have one of the highest accident rates of any industrial group.

The point of collection is another very important consideration. Aesthetics and economics are the criteria used in determining the point of collection.

Most communities have ordinances on the type, size, and number of containers as well as on the composition of acceptable residential solid waste. Compliance with these ordinances is very hard to enforce. Elected officials will not risk their political future by enforcing a crack down on ordinance violators.

Residents of poverty areas claim that they cannot afford proper containers. The fear of theft is also a factor discouraging these residents from buying containers. Some communities have solved this problem by providing containers to all residents.

Rubbish and bulky residential solid waste are also a problem. Frequently these wastes sit in piles for months awaiting a special clean up campaign. These piles are an eyesore as well as a definite fire hazard. Brick and concrete vaults have been used for rubbish collection but these are unsanitary, unsightly, a fire hazard, and very difficult to clean.

Studies are needed to determine current residential storage practices; evaluate the needs for new methodologies; to determine those characteristics that are the major constraints to adequate storage protection; to develop new storage methods; and to implement programs that will provide adequate storage methods.

B.2 Commercial Solid Waste

B.2.1 Current Technology

Storage subsystems for commercial solid wastes have not generally been developed as a result of sound planning. The required types and numbers of containers and their locations have evolved from an empirical approach. This approach is necessitated by the general lack of information on the amount or types of solid waste generated by various commercial enterprises.

Containers currently in use include: wooden and cardboard cartons; 55 gallon barrels without covers; standard plastic and metal containers; steel stationary packers capable of compacting the waste on-site; and large steel bulk containers. Each of these methods by necessity require a different collection subsystem and each subsystem may or may not be compatable with any other.

Generally, on-site location of these containers must be such that they can be effectively served by the collection subsystem. This means that each storage subsystem used results in different locational requirements. At the present time no procedure is available to optimize site location. Studies are needed to provide the basis for the development of methods to determine the most desirable storage subsystem for each commercial enterprise.

Little effort has been made to define the current storage subsystems utilized at commercial enterprises or evaluate the suitability of these subsystems to accomplish their function. The most recent innovation of stationary packers and bulk containers still pose problems in proper storage because of misuse and lack of needed design variables and parameters. The lack of concentrated and sustained effort to develop needed design data; and in evaluating and improving storage methods has placed a limit on the effectiveness that can be achieved with these methods.

B.2.2 Relationships of Current Technology to Management

Proper storage is determined by the type of container used; the ability to perform the function of durability, cleanability, manageability, and most important the provision for preventing nuisance, odor and health problems from occurring. The general cleanliness of the storage area is a function of these factors along with the proper usage of the appropriate containers. Although paper may comprise a substantial part of general commercial solid waste, the tendency for commercial solid waste to be stored at central locations and to be intermixed results in vector and odor problems because wastes from restaurants, produce markets and similar activities contain a large organic fraction.

In general, this tendency to combine storage subsystems precludes the development of effective reuse or reclamation methods for those components that could be recovered. The feasibility of accomplishing segregation on-site versus off-site is a subject that merits further study. Without data to support the hypothesis, we estimate that a great deal of reclamation by some large commercial enterprises is practiced. Paper products that can be readily segregated in sufficient quantity and quality at the source may be baled on-site and returned to the productive cycle. The potential of widespread use of recovery of fractions of the commercial solid waste stream will need further studies related to market and economic potential and technology feasibility.

The interrelationships between the storage of commercial solid waste and the total solid waste management system are not well-defined. The type of collection subsystem selected will dictate the storage methods unless knowledge of the unique storage requirements for commercial solid waste is known. As an example, waste that is decomposable requires storage and collection in a more stringent manner than certain other waste that does not pose the same degree of environmental problems. Knowledge regarding these interrelationships is essential for the planning and development of comprehensive solid waste management systems.

Storage regulations for commercial enterprises are frequently the same as with residential solid waste. Because of the vast differences between commercial solid waste and residential solid waste, common regulations do not appear to be logical or sensible. Studies are needed to determine the precise needs for each type of commercial enterprise in order to allow for the development of orderly regulations, etc. that are compatable to a comprehensive solid waste management system.

B.3 Industrial Solid Wastes

B.3.1 Current Technology

Industrial solid wastes storage practices is to a large extent, dependent upon the quality and quantity of the wasted material. A feasible and economic storage practice for a small amount of a hazardous material, e.g., drum storage of spent acid sludge, may be impractical and overly expensive for large amounts of the same material. The expense associated with impractical storage may lead to poorly managed collection and disposal operations and result in danger to, and degradation of the environment.

Generally, knowledge about specific solid waste storage is lacking. The precise storage requirements and present techniques are not known. Food processing industry solid wastes present special and almost overwhelming problems because they are easily degraded, represent vast amounts, and are seasonal in nature, i.e., the harvest season. On the other hand, sawmill wastes are relatively stable and may be stored for long periods without producing significant environmental problems. Some industrial solid wastes are in the super-hazardous category and must be stored indefinitely, e.g., radioactive waste sludges. The wastes that are common to all industrial activities are normally stored in a variety of types and sizes of containers. The nature and extent of industrial solid wastes storage practices is unknown and the problems related to these practices are assumed rather than proven. Because of the nature of solid waste management nationally, this assumption is relatively safe. Studies, etc. are needed to determine the current practices, problems, and needs in order to develop new methods, optimize current acceptable methods, and integrate the industrial solid waste subsystems into the total management system.

B.3.2 Relationships to the Overall Management System

Storage is an integral part of industrial solid waste management systems and usually the shorter the storage time, the more efficient the system. This is particularly true of putrescible wastes such as those associated with the food processing industry.

Many industrial solid wastes are disposed of on-site and therefore storage is minimal. Storage methods may effect the possibility of reuse. There is a lack of knowledge on the relationship of industrial solid waste storage to its management system. The storage subsystem and overall management system are inherently interrelated. The storage subsystem influences the collection and the collection subsystem influences the storage system. Current methods used within an industrial confine and its related technology and costs are not known. Further, the relationship that influences the broader management system of the community is not even defined. Perhaps better or different storage techniques would allow for government units to provide services to industry. Definition is needed to provide the basic data, etc. to make that judgement.

B.4 Agricultural Solid Wastes

B.4.1 Current Technology

Our understanding of current technology is incomplete. More information is needed which describes, in a quantitative as well as a qualitative manner, the current agricultural solid waste management subsystems and the associated requirements for storage.

Storage needs are influenced by the trend toward concentration of animals in restricted areas. Presently, storage practices are seriously underdeveloped. In cattle feedlot management, manures are often stored for 3-5 months in increasing layers under the feet of the cattle occupying the lot. In other situations, the manure is removed and stored in piles. In large, confined dairy cattle operations where manure is water carried, holding tanks are provided prior to lagooning or spreading on the land. The same general problem occurs in poultry management where litter--a mixture of manure, food and inerts--collects beneath the roosting birds. When it is removed it is usually stored in piles. The inadequacies of present storage practice cannot be definitively described since the innovation of newer disposal practices will most probably require radically different storage concepts. For example, a liquid carrier transport system, similar to a sewage line, would obviate the need for storage in some situations.

The harvesting of timber and food crops produces wastes which accumulate at the site of the harvesting operation. These wastes make an unknown contribution to pollution of water courses and, if they are burned, the atmosphere. Decaying plants also produce odors and vectors which cause a secondary set of problems in surrounding communities.

The debris resulting from logging and timber operations, estimated at 25 million tons/year, largely remains at the site at which it is generated.

The increasing use of pesticides to maintain high food production adds the pesticide residue and the container in which the materials are transported to the list of difficult-to-manage solid wastes. These materials, often toxic to mammals, are often procured in large quantities. Unused portions of pesticides and the container can be seen discarded; no present mechanism for storing such items is in operation. One of the main problems is that the division of responsibility between the supplier and the user for the unused items is not clearly defined.

B.4.2 Relationship to the Overall Management System

The growing interface of the urban-suburban and agricultural sectors requires a change in waste management practice. Solid wastes from both sectors must be managed in a coordinated system.

Present solid waste management practices do not provide a mechanism for handling agricultural solid wastes produced at the interface. The costs of treatment and disposal--formerly accomplished inexpensively by nature in low population density areas--are suddenly staggering. Agricultural solid wastes tend to be more putrescible than other categories and thus become noticeable sooner when improperly managed. The storage--or "environmental insulation"--of large quantities of agricultural wastes is a formidable task. Efforts are needed to develop this "insulation."

B.5 Institutional Solid Wastes

The concept of storage in the various categories of institutional solid wastes varies widely. Information related to these wastes and the related storage practices is incomplete and frequently unavailable. Further, the environmental effects of these storage practices, the procedures used, and the applicability and acceptability of the practices is unknown.

B.5.1 Current Technology

Hospital wastes are usually stored inside structures in cans with plastic or paper bag liners. Bulk storage is practiced at centralized points as intermediate storage following internal collection and prior to other unit operations. Single use cardboard cartons have also been successfully used. The use of single service container liners, paper bags or cardboard cartons reduces aerosol spread, eliminates odor and noise produced in transferring the refuse. Rupture of plastic bags of .0015 to .0020 gauge has been rare, even when used for cans and bottles. Paper bags are even less likely to rupture. However, the potential for cross contamination is existent and there is a need for development of more efficient, economic and safe procedures.

School, prison, and federal facility wastes are stored in much the same way as commercial solid wastes. Information on the storage of special military wastes such as munitions is not available outside the Department of Defense.

B.5.2 Relationship of Current Technology to the Management System

As with any waste, storage of institutional solid waste is an important step in the management system. Due to the potential contamination, hospital waste storage time should be kept to a minimum. Storage of special military wastes, like all other aspects of that waste management system, presents unusual problems.

C. Collection

C.1 Residential Solid Wastes

In the field of solid waste management, collection, to the resident, is the most familiar unit operation. The citizen might be totally unaware of the disposal method for his solid wastes or even where the disposal operation is located, but he is very familiar with the collection system and how it affects him.

The Interim Report of the National Survey of Community Solid Waste Practices indicated that, on the average, approximately $5.39 per person per year is budgeted by communities for collection activities. It is assumed that the greatest share of this sum is for residential solid wastes collection. This sum represents an estimated 80% of the current total for collection and disposal costs.

Improvements in collection methods have developed slowly. Even though compactor trucks have increased the efficiency of the operation, they are not radically different from the mule and wagon used 50 years ago. New and innovative subsystem development is needed to cope with the ever increasing and changing amounts and characteristics of residential solid wastes.

C.1.1 Existing Methods

Collection subsystems may be based upon many factors including type of residence, neighborhood configuration, local customs, etc. Table 6 describes the major type of residential collection subsystems: curb service, alley service, set-out/set-back service, set-out service, and backyard service.

With curb service, the homeowner places his solid wastes container(s) at the curb on the scheduled day. Pickup men dump the wastes into the collection vehicle and replace the container at the curb. The homeowner must return the container to its normal storage area.

With alley service, solid wastes containers are stored on the homeowner's property at the alleyline. Pickup men empty the containers into the collection vehicle and replace the container in its normal storage area next to the alley.

With set-out/set-back service, "set-out" men go house to house taking full trash cans from yard to curbline; other men stay with the truck to empty cans; "set-back" men return the empty cans to the owner's yard.

With set-out service, the collector brings the waste can from the yard to curb and empties it. The homeowner carries the empty container back to the yard's storage area.

With backyard carry service, the collector carries a tote bin or burlap cloth to the yard, empties the can

Table 6

Comparison of Residential Collection Services

	TYPE OF SERVICE				
CONSIDERATIONS	CURB SERVICE	ALLEY SERVICE	SET-OUT SET-BACK SERVICE	SET-OUT SERVICE	BACKYARD CARRY SERVICE
Requires homeowner cooperation:					
a) to carry empty cans	YES	OPTIONAL	NO	YES	NO
b) to carry full cans	YES	OPTIONAL	NO	NO	NO
Requires scheduled service for home-owner cooperation	YES	NO	NO	YES	NO
Poor aesthetically:					
a) spillage and litter problem	HIGH	HIGH	LOW	HIGH	LOW
b) cans visible	YES	NO	NO	YES	NO
Attractive to scavengers	YES	HIGHEST	NO	NO	NO
Prone to upsets	YES	YES	NO	YES	NO
Average crew size required for efficiency*	1-3 MEN	1-3 MEN	3-7 MEN	1-5 MEN	3-5 MEN
Crew time*	LOW	LOW	GREAT	MEDIUM	MEDIUM
Collector injury rate due to lifting and carrying	LOW	LOW	HIGH	MEDIUM	HIGH
Trespassing complaints	LOW	LOW	HIGH	HIGH	HIGH
Special considerations		Requires alleys and vehicles that can maneuver in them; less prone to block traffic; high vehicle and can depreciation rate			Requires wheeled caddy to roll filled barrels or the use of burlap carry cloth or hand carry bin; works best with driveway
Evaluation based on service to home-owners; cost due to crew size and time requirements	Poor service, low cost	Fair service, low cost	Good service, high cost	Fair service, medium cost	Good service, medium cost

* Presumes use of standard compactor vehicle.

into the bin or carrycloth, replaces the container, and carries the solid wastes to the collection vehicle.

There are, of course, many modifications and adaptations of these methods to fit particular community needs, including the use of scooters, caddies, trains, etc. The five methods listed, however, are the basic systems now in wide use.

Route and crew organization patterns must be integrated with the type and frequency of collection, the amount of solid wastes to be collected, and the storage subsystem. For example, provision must be made to accommodate seasonal variations. The first pickup of the week is usually heavier than the second; thus the daily work load may vary considerably. Since neighborhood conditions differ greatly, routes must be planned and adjusted on an individual basis.

Most higher density dwellings such as apartment complexes and high-rise apartment buildings use large containers which are emptied with special equipment, or in some instances, compaction units that compact and store in containers the solid wastes for collection.

The compactor collection vehicles are becoming common in most collection systems because of economic and sanitary advantages over open trucks. Some economic advantages are: (1) the ability to carry larger loads due to compaction, (2) low loading height, and (3) they are built to withstand corrosion and abrasion from contents. The compactor vehicle is not without limitations. It cannot handle large bulky objects, is quite noisy, is especially susceptible to mechanical problems due to the harsh environment in which it operates, and represents additional vehicles on the already overloaded urban transport system.

Other collection methods include detachable container methods, train systems and three-wheeled scooters for light collection.

The Bureau has studies related to collection, such as one-man collection systems, liquid slurry collection systems, and pneumatic systems. The knowledge gaps in the field of waste collection are great and much work is needed to develop the basic data related to collection and to identify areas requiring developmental and application effort.

The need is great for systems which do not depend to such a great extent upon manpower. This dependency renders a collection system especially vulnerable to problems inherent in any subsystem utilizing large labor forces.

C.1.2 Application of Methods

The Interim Report of the National Survey of Community Solid Waste Practices estimated that 64 percent of the population lives in communities that operate some type of collection service. The survey also estimated that 48% of the population received once weekly collection; 32% twice weekly collection; and 20% at other intervals or not at all. The distributions of equipment types, etc. are known only in general terms, i.e., approximately 100,000 compact trucks, 180,000 vehicles other than compact units, etc. However, this survey is producing only gross data and data that completely describes the characteristics of residential solid waste collection subsystems is needed.

C.1.3 Public and Private Owned Collection Subsystems

Solid waste collection is rather unique when compared with other utilities in that a large portion of the work is performed by private contractors. This fact holds true for all classes of solid wastes and can be referred to in this plan in the discussions on all solid wastes. For residential solid waste collected, it is estimated that 56 percent is collected by public owned subsystems, 32 percent by private owned subsystems, and the individual householder himself must take care of 12 percent of the household wastes.

Data regarding the private sector of the field is not as readily available as public sector data. This paucity of data creates constraints in the development of comprehensive solid waste management systems. Until needed data is available regarding the contributions, capacities, and capabilities of the private sector of the field, it will not be possible to understand the full extent of the solid waste management problem and develop adequate solid waste management systems at various levels of government.

Regardless of the collecting agency used, residential solid waste collection is a governmental responsibility and should be under the constant control and/or supervision of the municipal (or other appropriate) political authority.

C.1.4 Personnel

The collection of solid wastes consistently ranks at the top of the list of hazardous professions with the occurrence of serious accidents three times that of industry in general. This problem demands attention from a humane standpoint as well as a purely economical one. Because of the low salaries, public attitude, and lack of opportunity for career enhancement there is a high "turn-over" rate in solid waste collection personnel.

These problems must be defined and understood, and programs developed to minimize the effects, etc. of these problems, or if possible eliminate them.

C.2 Commercial Solid Wastes

C.2.1 Existing Methods

Collection subsystems for commercial solid waste are intimately related to the comprehensive solid waste management systems of most urban centers. Most commercial solid wastes are disposed of in municipal disposal facilities. Frequently, residential and commercial solid wastes are collected by the same collection subsystem and comprise the waste archiacally termed "municipal solid waste." The close relationships between these entirely different wastes needs to be completely defined.

The methods for collecting commercial solid waste is closely interrelated with the storage practice used. Rear and side loading compaction vehicles are in use for small commercial enterprises much in the same manner that residences are serviced. This frequently involves the use of small storage containers that are emptied by collection crews. Front loading compaction vehicles can be used in the same manner, but also have the added flexibility of being able to unload bulk containers that cannot be managed by one man of a collection crew. Special vehicles are in use for collecting large portable bulk containers by removing them from the storage area and leaving an empty one in their place. Stationary compaction units are receiving increased attention by the commercial sector. Open bodied vehicles are allowed when the quality of the wastes is such that they pose no problems incompatible with environmental criteria. The amounts and application of each of these collection subsystems is not known at this time.

Collection frequency naturally varies with the characteristics of the wastes stored. A primary factor determining the frequency of collection should be the amount of organic matter present. At the present time, the determining factor is not known. Waste containing organic material is most often collected at least daily and frequently more often than this. Wastes that have little or no organic fraction may be collected at various frequencies, from daily to one to three times per week; once every two weeks; etc. depending on the amounts generated and the storage capacity available.

Detailed evaluation on the performance of present commercial collection subsystems and their efficiency in accomplishing their function is not available. Consequently, the basis for systematic improvement has been based on empirical approaches. This is reflected in an area of solid waste management that has represented a major share of the dollars expended for solid waste management and is also the occupation with the highest accident and injury rate in the nation.

Collection methods within a commercial enterprise has not received major study. In most instances the in-house collection from the generating locations and delivery to the storage area is performed manually. Small enterprises have their regular personnel perform this function whereas larger enterprises may have this performed by janitorial or maintenance personnel. Some large commercial establishments such as office buildings use a chute system for transport of the waste from a central location to the storage area. However, manual methods must still provide the collection and transport from the generation point to the chute location. The methods, cost, efficiencies, etc. of these practices are not known.

C.2.2 Application of Methods

Specific quantification of the application of each collection method; the acceptability of each method; the amount of each type of equipment in use; the number of men and amount of money expended is not available. Likewise, records from which this data might be obtained is often nonexistent or kept in a very random fashion. Therefore, meaningful results can only be obtained from these records by careful investigation and on-site discussion with personnel.

A standardized cost accounting and recordkeeping system to the maximum extent possible would aid in correlating the data so that the effort expended can be quantified into interpretable facts. The Interim Report of the National Survey of Community Solid Waste Practices estimated that about only 30% of the communities surveyed budgeted any funds in the specific category of commercial solid waste collection. This need is existent for all solid waste management systems of all types of solid wastes.

C.2.3 Public and Private Collection Subsystems

It is estimated that commercial establishments are most frequently served by private rather than public collection subsystems. The basis for such service practices is not known. The Interim Report of the National Survey of Community Solid Waste Practices estimated that on a population basis 62% of commercial solid wastes are collected by private collection subsystems, 25% by public collection subsystems, and the remainder by the commercial enterprise itself. It should be noted that the definition by population does not suffice for the quantification needed in this area of interest. Information related to which type of collection subsystem serves a given type of commercial enterprise and the amounts of commercial solid wastes collected is not known.

C.3 Industrial Solid Wastes

C.3.1 and C.3.2 Existing Methods and Application of those Methods

Industry has led the way in the utilization of advanced methods of containerized collection subsystems. Early BSWM* studies indicates that industry uses certain basic collection techniques, although the amount of factual information is extremely limited. At the present time, it must be assumed that the collection methodologies are broadly similar but individually applied. For the solid wastes common to all industry the collection equipment used is similar to that utilized by the residential and commercial sectors. One difference is that the equipment tends to be larger sized.

Each SIC manufacturer, no doubt, has unique solid waste management problems that require equally unique collection subsystems. Specialized and expensive equipment is frequently needed for these unique problems. Some examples are vacuum tank trucks for chemical sludges, heated truck containers for viscous materials, special portable containers for unstable and toxic solid wastes.

*Bureau of Solid Waste Management/Environmental Control Administration, Consumer Protection and Environmental Health Service

Current collection methods for industrial onsite and off-site operations are assumed to be:

Onsite	Off-site
pneumatic	vehicular
hydraulic	
vehicular	
Other miscellaneous	

Each industrial solid waste collection subsystem must be developed to fit the product line and the necessary storage methods for difficult waste streams. Because of the need to recycle or reuse valuable waste products, collection must be designed to return those wastes that may be used again; transport those wastes to other processing centers that use the wastes as a raw material; or collect for final disposal.

At the present time no real information is known on the above that would allow for a realistic picture of industrial solid waste collection practices; the costs; manpower; or the amount of investment in industrial solid waste collection subsystems. Planning for future needs is not possible without such data. The possibility of incorporation of various solid waste streams or the development of comprehensive solid waste management systems that combine industrial and nonindustrial solid wastes is not possible without a complete factual definition of current technology. The translation and transfer of technology between industries and local areas is not possible without the missing information.

It is desirable to know by SIC the methods of collection; the amount of manpower involved; the amounts and types of equipment; the collection costs per waste unit; unique subsystems that are peculiar to a specific industry; the efficiencies of these systems; the effects of each subsystem type on the environment; the design requirements for each industry; and the possibility of incorporation (amalgamation) of community and industrial subsystems.

C.3.3 Public and Private Collection Subsystem

Industrial solid wastes are collected by the industry, by contract haulers, and by community subsystems. Early BSWM studies indicate that approximately 75% of industrial solid wastes are collected by the industry itself; 21% by contract hauler and the remaining by communities. The technology used; the types and amount of equipment, manpower, etc.; and the cost, by each subsystem however, are not known. Further, the efficiencies, problems constraints, relationships between the three are not understood. Finally, who has regulatory authority, etc., is completely unknown at this time. As stated in previous sections of this plan, the interrelationships between these subsystems must be defined to provide an adequate base for development of future comprehensive solid waste management systems.

C. & D.4 Agricultural Solid Waste

C.4.1 and D.4.1 Existing Methods (Collection and Transport)

Collection and transport of agricultural solid wastes cannot generally be discussed under the same concepts as with other solid waste sources. Practically all of the crop and forest wastes, a large portion of animal and poultry manures, and some unknown portion of pesticide containers are not collected nor transported from the site of generation or use but "disposed of" on site. Most of the crop and some of the forest wastes are returned to the land in place through natural processes or cultural operations. Much of the forest wastes and some of the crop wastes are burned at the site. Technical and economic feasibility for doing otherwise is largely unknown and needs to be determined.

In the case of manure handling at concentrated animal growing operations, however, collection may be one of the major unanswered problems. In current practice, animal quarters are infrequently cleaned (i.e. the waste is infrequently collected). In feedlots, an accumulation of several inches of manure is not unusual. In poultry and dairy operations, similar conditions develop. Under these conditions, fly breeding, odors and manure dust become problems. Even when quarters are cleaned it is usually through manual means.

C.4.2 and D.4.2 Application of Methods (Collection and Transport)

The methods for the collection and transport of agricultural wastes are related to an older rural-agricultural situation and do not offer a solution for the urban-agricultural problem of today. It is probably that improvement of collection could result in more environmental benefit than the modification of any other unit process.

C.4.3 and D.4.3 Public and Private Collection Subsystems (Collection and Transport)

Although urban-agricultural wastes could be collected as a municipal responsibility, such an arrangement would be out of step with the concept of placing the responsibility for wastes from a private enterprise with that enterprise. The potential and feasibility of subsystems for agricultural solid waste utilizing public and private resources needs to be completely explored.

C.5 Institutional Solid Waste

C.5.1 and C.5.2 Existing Methods and Application of those Methods

Trash chutes have been used in hospitals to collect combustible wastes. The trash is collected in plastic or paper bags by maintenance personnel; the bags are sealed and fed to the chute. Hospital food wastes are typically fed to a food waste grinder. Housemen performing collection should be carefully trained in the protective techniques necessary for proper handling of pathogenic wastes, such as: the use of gloves, gown, and filter mask; methods of handling containers to minimize aerosol spread; and proper closure techniques if liners are used.

Since incinerator facilities must be provided for infectious wastes, many institutions have built incinerators capable of handling all hospital solid waste, thus requiring only collection of incinerator residue.

For the most part, solid waste from schools, prisons, and military facilities is collected in packer trucks in very much the same way that residential and commercial solid wastes are collected. School solid wastes are already separated and many times the paper is incinerated on site, while the cafeteria wastes are collected. Outside the Department of Defense, very little is known about the collection of special military wastes such as munitions.

C.5.3 Public and Private Collection Subsystems

Although it is believed that private collection of institutional solid waste is more common than public collection, definite knowledge on the split is not available. At times municipalities are unwilling to take the risk of collecting hazardous hospital wastes so they must be privately collected. Many institutions collect their own wastes.

D. Transport

D.1. Residential Solid Wastes

The movement of residential solid wastes from its point of generation or collection to the processing or disposal site is an important economic factor in planning, designing and operating a solid waste management system. Because both solid waste generation and traffic problems are for the most part population oriented, it becomes imperative to consider the inter-related demands between highway use and solid waste transport. Equally important are the technologic and health related factors involved with moving a rather unappealing and potentially hazardous material through the urban areas in somewhat concentrated form. It is essential that effort be directed to determining, in specific detail, the dealth, economic, aesthetic, and technologic factors involved with transporting residential solid wastes and to develop and apply processes and techniques that consider these factors in an acceptable manner.

D.2. Commercial Solid Wastes

There is a strong relationship between residential and commercial solid waste quality which could allow the application of residential solid waste management technology to commercial solid waste management. The transport function of residential solid waste transport subsystems may be applicable to commercial solid waste. However, in the realm of long distance transport the economic impact will require specific studies directed primarily toward commercial solid wastes.

Pneumatic and hydraulic transport on the other hand may find applications in large commercial establishments or commercial complexes regardless of the applicability of these transport mechanisms for residential solid wastes. Here again studies of commercial solid waste could utilize the data developed from completed residential solid waste investigations until the time when the needed studies of commercial solid wastes are completed.

D.3. Industrial Solid Wastes

The relationship between the collection and transport of industrial solid wastes is assumed in many instances to be inseparable. In those instances where transport is totally interrelated to collection, discussions will be provided in the collection section of this plan. It is assumed that a certain amount of transport following collection is accomplished where the collection vehicle or subsystem is not utilized. For instance, some industries collect waste sludges in tank trucks and transport the material by barges to disposal sites. Pneumatic collection systems are sometimes used and followed by truck transport to another processor disposal site.

The order of magnitude of each effort is not known. It is further assumed but not substantiated that the methods of transport is similar to those commonly used by other sectors of the solid waste management field. Again the practice, methods, and order of magnitude of these efforts is not known. Studies are needed to identify current efforts, the technological methodology of such efforts, and the possibilities of incorporation of these efforts with other transport systems. This knowledge would enable planning efforts to consider the interfaces of significance that exist between various portions of a total solid waste management system; to determine the need for more efficient methods of transport; the potential markets for new and innovative equipment; etc. Further, each industrial group, no doubt, has various transport needs that cannot be answered without complete identification of the current practices and efficacy of these practices.

Certain existing constraints, both political and geographic, may preclude more intelligent management of industrial solid wastes. Additionally, the small amounts of certain troublesome solid wastes sometimes do not make it possible for a specific industry to develop a unique treatment system for that waste. Whereas, if more than one industry could join efforts a common waste treatment facility might be developed, or a community (s) could develop the needed facility that could take the wastes of many different processes. At the present time such efforts are rarely heard of, and the potential for reality of such efforts is dismal. This is due to transport regulations that prevent such efforts, the resistance of government agencies against the transport of wastes across political boundaries, and similar problems. Studies are needed to identify the areas that prevent sometimes desired actions in order to diagram adequate methods in the future that will optimize needed systems.

D.4. Agricultural Solid Wastes

See C.4.

D.5. Institutional Solid Wastes

The methodologies for the transport of institutional solid wastes are very similar to residential and commercial solid wastes. Special precautions must be taken to transport waste munitions from defense facilities and contaminated wastes from hospitals.

The same demographic problems which occur with residential waste transport occur with institutional waste transport.

E. Processing

E.1. Residential Solid Wastes

Due to the heterogeneous nature of residential solid waste, it is rather difficult to make general statements regarding its adaptability to various processing methods. This problem might be solved to a degree by having citizens segregate their solid waste according to properties, but this idea has proven unpopular to the average citizen.

In composting, compaction, and at times, incineration, grinding is used as a preliminary step in the processing system to increase the homogeneity of the refuse.

The increased use of food waste grinders has lowered the percentage of organic wastes in residential solid wastes. This fact, coupled with the increased use of paper products, has raised the overall heat value and somewhat enhanced the use of incineration as a volume reducer. However, these same situations have necessitated changes in composting and other processes involving aerobic decomposition.

In order to reutilize the various components of residential solid wastes separations method must be developed and until such methods are developed reutilization techniques will be found lacking.

Residential solid wastes are not particularly adaptable for processing onsite. This problem necessitates communities providing central processing subsystems or to dispose of solid waste through incineration and land filling. The political, technical, and economic constraint placed upon processing due to demographic interrelationships must be minimized before effective processing can be achieved.

With the country's supply of valuable materials relatively fixed, the importance of reutilization cannot be over emphasized. Most authorities feel that it is within this area that a final solution to the solid waste management problem must be found. However, realism of the facts about solid wastes and the many cross constraints related to solid waste management must be a part of any reuse conceptualization.

E.2. Commercial Solid Wastes

As discussed earlier, an estimated 1.5 million tons of commercial solid waste is collected for off-site processing each day in the U.S. A similar amount is possible processed on-site. Because of the lack of available information, no reliable estimate can be made of the quantities being processed on-site, or the processing methods. The major portion of the material processed on-site is presumed to be by thermal reduction (burning in one form or another), while that which is collected is processed by municipal or privately owned facilities.

Unknown quantities of cardboard paper are salvaged for reuse or for raw materials in the production of packaging and building materilas. In some areas, food wastes from restaurants are still processed (pasteurized) for hog feeding.

However, stringent health regulations imposed on this practice has reduced its attractiveness and it is decreasing in application.

A very small quantity of commercial solid waste is currently being processed at compost operations. In this process, easily biodegradable materials are reduced to a humus-like material. However, the overall process is costly, the paper and plastic content make composting difficult, and markets for compost have not developed.

Based on the apparent compostion of commercial solid wastes, any processing subsystem properly designed to process residential solid wastes should be able to process this material. However, processing facilities such as incinerators and compost plants are designed primarily on an empirical basis due to the lack of knowledge of the characteristics of residential and commercial solid wastes. To properly design process subsystems for commercial, residential or other solid wastes, data related to the physical structure of the wastes to be processed; moisture content; percent organic or combustible; the amount of inert material; etc. must be known. As an example, for incinerator design the Btu value of the commercial solid waste must be known and for plants that separate the wastes into different categories for salvage and reuse the amounts of various waste constituents i.e. paper, metal, etc. must be known.

The generation points for commercial solid wastes are well known so far as types of establishments contributing. The general nature of the material is also known. For instance, we know that banks and office buildings generate almost entirely paper wastes while restaurants and groceries or markets produce a rather large percentage of organic materials. However, very little is known of the quantity and true quality of material generated by the many different types of enterprises.

This information must be developed if we are to take advantage of the fact that commercial solid wastes occur in relatively large homogeneous concentrations and are good subjects for recycling.

Commercial solid wastes appear (not fully substantiated) to have an extremely high percentage of combustible matter. This would suggest that emphasis be placed on developing on-site incineration processes which can satisfactorily process this material while meeting effluent regulations. Based on present incinerator technology in the United States, research and development work to develop new small-scale incinerators that provide maximum volume and weight reduction while meeting an 0.2 g/scf @ 12% CO_2 stack emission regulation and a 5% or less combustible portion remaining in the final residue regulation is needed.

New processes now under study such as the "UNIMELT Process" (Erie, New York) and the "Vortex Process" (Shelbyville, Indiana) offers some promise in this area.

The apparent large percentage of paper contained in commercial solid wastes indicates also that a much greater emphasis could be placed on salvaging this material. In some areas of the country, industry is paying up to $20/ton for baled waste paper for use in the production of packaging and building materials. However, studies must be undertaken to determine the types and quantities of waste paper present in commercial solid wastes having salvage value; potential markets for these wastes; and efficient, economic and automatic processes to salvage these wastes for reuse. Present collection subsystems are not geared to the salvage-reuse concept. Studies to determine the optimum management arrangement for the salvage-reuse of commercial solid waste is needed.

If we had knowledge of quality and quantity of material produced by commercial enterprises and good techniques of predicting generation rates, processing subsystems could be properly designed so that collection subsystems serving those enterprises could provide the necessary systems management to assure salvage-reuse. Electronic signals and computer systems could be used at a central location to determine from input by the collection subsystem such information as generation, source, type and quantity of material collected, etc. This information could be quickly compared against daily and even hourly salvage demands and the trucks could be routed directly to the proper processing facility. This information would benefit the processing plant operator and the salvage material user as well.

New innovations in the processing of solid waste may improve public acceptability of solid waste management. Grinding (size reduction) of commercial solid waste prior to processing and/or disposal appears to be feasible. At a CPEHS/ECA Demonstration Project in Madison, Wisconsin, the technique of size reduction is being studied. Although the processing facility and disposal site is located close to a residential area and across the road from the municipal auditorium there have been little or no complaints on the operation during the two years of existence. At the present, grinding costs appear high but new studies and technological development are needed to produce processes that will be economically feasible.

Baling of commercial solid wastes on-site or at a processing plant prior to reuse or disposal requires further definition and development. Present equipment, etc. is slow and inefficient. If baled commercial solid waste can be transported to a disposal site to increase the stability of the constructed fill and reduce hauling costs, great benefit can be achieved.

E.3. Industrial Solid Waste

The uniqueness and usual homogeneity of industrial process solid waste often make them adaptable to upgrading processes or recovery techniques. Where possible and practical, solid wastes are processed for recycling, reuse, or reclamation within the particular industrial segment. The most common processes presently in use are illustrated in Figure 1:

Figure 1

Industrial Solid Waste Management Processes

- Separation
  - Manual
  - Mechanical
- Size Reduction
  - Shredding
  - Grinding
  - Milling
- Compaction
  - Mechanical
  - Natural
- Composting
  - Windrow
  - Mechanical
- Incineration
- Burning
  - Open
  - Confined
  - Pit
  - Conical burner

The above processes can lead to physical, chemical or biological changes that make the waste material suitable for reuse, further processing or disposal. Yet, information related to the application of each process and the level of technologic development of the process as used by industry is not known. However, it is already known by the **CPEHS/ECA solid waste program that major research and development efforts are needed to develop methods of wastes def**inition, separation of various wastes, and better techniques for size reductors.

It is assumed that most of the SIC groups to be considered in this plan use some or all of the processes listed. The exact application, importance, and order of magnitude of each is not known. The level of technology for each of these processes is not known or how a successful process from one industrial solid waste process may be applied to another. Because processing offers the most opportune possibility for major break-throughs in developing reuse improvements major effort by the

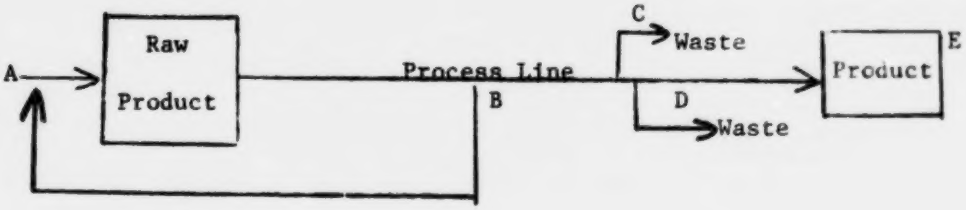
Studies are needed that will adequately describe current solid waste processing methods within each industrial group; the amounts of wastes being handled by each process method; the impact of each process method on the environment, the capital and operating costs; and the possibility of technology transfer **between** industry groups onto nonindustry applications. Further, studies of the characteristics of specific industrial solid waste are needed to identify the controlling factors that determine what process is selected for that particular waste. The identification of those characteristics i.e. compactibility, degradability, etc. should provide insight into the need for new process approaches not presently under development. The interface of industrial solid waste processes and other solid waste processes needs definition and delineation.

The definition of industrial solid waste processes must be supported by a complete understanding of the adaptability of each solid waste to processing. At the present time, little or no data is available from each SIC group regarding this important aspect of industrial solid waste definition. The waste from one industry could be the raw material for another, providing such definition is developed and if adequate processing were to be included in the management of the waste.

Many industries do not consider that any material that is collected from the process line and recycled is waste. Yet, without knowledge of the order and magnitude of practices, no materials balance can be developed for an industrial process. Further, the development of new material resources from potential waste by (-) products disposal systems cannot occur. Figure 2 illustrates this concept.

Figure 2

Industrial Process Materials Balance



A + B = C + D + E

(Without B no real definition can occur)

Existing regulation, rules, and legislation may be an impediment to meaningful processing. The lack of consistent regulations over a broad geographical area may give one industry advantage over another. At the present it is assumed, perhaps erroneously, that regulations do not hinder the concept of reuse, etc. However, what would be the effect of legislation that would place certain requirements on the development of new products that assured that the processing and disposal of the waste produced would be provided for. Studies of such effects need to be conducted. As an example, what would be the impact on the automotive industry if a Federal regulation required modular fabrication of those components that required removal prior to processing the metal of the vehicle. Such studies are needed to define the real potential of reuse, recycle, reclamation, etc.

E.4. Agricultural Solid Wastes

The present practices associated with the processing of these wastes are directed only toward keeping the waste from interferring with the operation. Discarded agricultural materials which are being recycled have been propelled by sound economics and the expectation of a monetary return. Processing related to acceptable disposal practice--e.g. incineration, grinding, dehydrating, baling, composting, lagooning--is not being pursued to any significant extent. Disposal-related processing requires bold new approaches and acceptance of the concept that such processing will increase costs. Information on the physical and chemical characteristics of manures is available. However, the corresponding data on the various crop and forest wastes are meager.

The high organic content of agricultural waste makes it a strong candidate for reclamation in some form. Composting of animal manure and cannery wastes is practiced to a small degree. Lagooning of animal wastes as a processing step has received considerable research attention. It is, however, hampered in colder climates and fraught with odor problems.

One of the obstacles is obtaining reimbursement of processing costs for agricultural wastes. In particular, the costs of producing high grade nitrogenous materials that have fertilizer or feed value are important. More information is needed on the incentives which would be required to induce fertilizer products to accept solid wastes as a source of nitrogen.

E.5. Institutional Solid Wastes

Of the institutional wastes mentioned previously, those from hospitals and military bases probably are the only ones processed differently from wastes which come from other sources. Most of the other institutional wastes are of such a character that they can be processed along with residential and commercial solid municipal wastes.

Large military bases generate solid wastes common to comparably sized civilian communities also generate munition wastes. While it is obvious that incinerating such wastes would be dangerous, it might be just as dangerous to dump or bury these wastes. Special processes have been developed within the military structure to handle these wastes.

There are two unique factors which distinguish processing of solid wastes from military bases and administrative or headquarters facilities: (1) maintaining security in the disposal of classified documents and materials and (2) management and attitudes necessary for maximum reclamation of resources. The first is reflected in past and present practices of shredding, pulping, or burning of such wastes and the second is in either source separation or subsequent classification and recovery of valuable materials. An additional element to be considered is one of degree rather than kind; this is the more effective control of operations by the military than that exercised by civil, industrial or other authority. This is usually reflected in the level of housekeeping in military installations.

The wastes generated by a hospital are common to most communities and create processing problems. The principal types of hospital solid wastes are: (1) food wastes, (2) paper, trash and other dry combustibles, (3) treatment room wastes, (4) surgery wastes, (5) autopsy wastes, (6) noncombustibles such as cans and bottles. Some of these wastes, such as autopsy and surgical wastes are contaminated and cannot be processed through conventional channels due to the high probability of a sanitation worker being infected. Further, the aesthetic aspects require special consideration in relation to processing. The remainder of the wastes can be managed by the community systems.

Generally, incineration facilities must be provided by the hospital for the disposal of infectious wastes. Many institutions have built incinerators large enough to handle all of their solid wastes. Two principal types of multiple-chamber incinerators are currently in use--natural-draft and heavy-duty, high-temperature. The latter is preferable because the high temperatures provide a better chance for acceptable destruction of pathological and laboratory wastes, wet wastes, and other high-moisture-content materials.

The Bureau has issued publications and sponsored conferences dealing with hospital wastes. Since hospitals are common to most communities and the problems both unique and potentially serious, work is required in this area in the future to develop adequate subsystems, etc. to provide acceptable practices. Adequate information on the processing of the wastes from other categories of institutional wastes is practically non-existent.

A major significant area that must be developed and promulgated is the recognition that planning for proper solid waste processing in institutions is an integral part of facility development.

F. Disposal

Disposal is the final step in the solid waste management system. After proper disposal nothing more need be done. Incineration is not disposal because there is still a residue and fly ash requiring disposal. Unfortunately, disposal practices in this country are by far the least satisfactorily implemented step in the management system. Less than six percent of the regulated (government controlled) disposal sites in the country can even be called "sanitary landfills." The rest of the sites are open dumps. There is a need to upgrade these sites.

Only one form of land disposal is now practiced which is considered a safe, efficient and sanitary method of disposal - sanitary landfill. A true sanitary landfill is operated well above the highest know level of the water table. The waste is compacted while working in the smallest practical working area (maintains a small working face) to the highest practical density and covered daily with at least 6 inches of clean compacted earth cover. This method of disposal, although it could do much to alleviate poor solid waste management practices, is not widely practiced - contrary to the statement of some of the nation's well-known consultants. Some consultants say up to 50% of all of the nation's solid waste is disposed of by means of sanitary landfill. This is not so. While up to 75% or better of the country's solid waste may be dumped on the land, it is estimated that less than 15% is actually sanitary landfilled.

Many land disposal operations are called sanitary landfill which in fact do not come close to meeting the criteria and requirements of a sanitary landfill. The average citizen or property owner may oppose the location of a sanitary landfill operation as violently as he would an open burning dump because of the stigma of landfill operationsand the fact that many public officials still refer to poor landfill operations as sanitary landfills. There is a great need for public attitude surveys for studies of the factors which cause people to reject the location of sanitary landfills and studies to develop ways to motivate people to accept the fact that landfill disposal operations are essential to every day living.

Entirely too much solid wastes are dumped at promiscuous dump sites. This is a blight upon the community and degrades the environment. The presence of such dumps hastens the depreciation of the adjacent land and has a negative psychological effect on the citizens.

Programs, finances, etc. to clean up these dumps by either converting them to sanitary landfills or removing the solid waste to an acceptable disposal site are needed.

To handle this particular phase of the disposal problem the technology is available but without funds the technology is not very helpful.

The primary method of disposal is still the open dump with its many negative aspects. Although the actual number of these legal dump sites is unknown, enough is known to estimate that they exceed 250,000 for the entire United States. In fact, to say there are over

1,000,000 may be conservative. The cost of closing the dumps or converting them to sanitary landfills is enormous. Work is needed to develop more economical methods of sanitary landfill construction and operation.

Although much work has already been done concerning the construction and operation of sanitary landfills, much more needs to be done to determine and eliminate side effects on the environment (groundwater pollution, leachate, gas production, etc.).

The sanitary landfill will be the primary disposal method for most of the country through the year 2000. Efforts, studies, etc. to fill knowledge gaps, disseminate this knowledge to the public and overcome current negative attitudes toward sanitary landfills are needed and necessary.

Mine disposal of solid wastes and residues from solid waste process operations may have promise in rural areas. This method used in conjunction with railhaul of solid waste could be used to reclaim thousands of acres of relatively useless land in the northeast section of the country. The land might be reclaimed quickly, even as the mining operation progresses, by hauling solid wastes (by rail or barge) from large cities to such disposal sites. Studies to determine the feasibility of such methods and the development of needed technology is needed.

For cities near the coasts, ocean disposal could possibly be an excellent disposal site and with land available for use as sanitary landfills becoming more scarce the ocean is looking more attractive. This idea is certainly not new. Ocean disposal has been practiced in the past with unpleasant results.

This subject requires special attention by **CPEHS/ECA in the immediate** future. Although ocean disposal is practiced by government and industry, the amounts, effects, etc. are not known today. The effects of such practices on the marine ecology needs definition. The design characteristics for sea disposal systems must be developed if studies indicate that this method, when properly operated, will not injure this last unspoiled resource. Complete feasibility and environmental studies are needed to determine the effect of ocean disposal on the marine ecology. Criteria, standards, etc. must be developed prior to development of this disposal method.

Investigations are needed to determine the extent of current solid waste disposal at sea and the **ECA is currently assessing the over-all** level of activity of ocean disposal in an effort to grossly quantify the amounts and types, identify the impact, and judge the areas requiring priority effort. Until the full facts are known, ocean disposal of solid waste should be strongly curtailed or, if possible, not permitted at all.

Information concerning the types and amounts of each type of solid waste going to each disposal method; the costs of such methods; the effect on the environment; and the reasons each particular method is used is inknown. Further, the costs assigned to each activity for the disposal of their wastes should be studied to determine the cost/benefit, fairness, etc. of current charging methods of solid waste management systems.

The problem of industrial solid waste disposal is compounded by some of the known unique characteristics of industrial solid waste, i.e. extreme toxicity, corrosion, etc. A previous study conducted for the CPEHS/ECA by contract indicated that approximately 75% of the industrial solid waste requiring disposal is handled by municipal disposal sites. This would indicate that of the 110 million tons per year of industrial solid wastes, approximately 77 million tons reaches disposal facilities outside the plant property. It is assumed that the major portion of the 77 million tons are of the general plant waste type and not the special process wastes previously discussed.

The disposal of agricultural wastes is perhaps handled more primitively than other varieties. Common disposal practice encourages returning agricultural wastes to the soil. This type of disposal worked reasonably well when agricultural operations were on large tracts of land. Presently, however, the trend in agriculture is the encouragement of greater production from smaller land areas. The smaller land areas--mostly closer to the urban area--will not permit simple land disposal. Consequently, accumulations of wastes occur. Incineration is applied only rarely to these wastes. It is uncommon to hear of agricultural wastes being placed in a landfill. Open burning with attendant air pollution problems does occur frequently. The disposal problem associated with the manure in feedlots and dairy operations is intense. No system of disposal exists for waste pesticides and their containers. Barriers to the development of adequate disposal systems for animal wastes include: (1) the difficulty in accepting the costs associated with disposal, (2) the favoring of the "return to the land" concept over a modern engineering approach to waste and wastewater treatment, and (3) a lack of sufficiently specific data to understand the problem.

G. Management

G.1. Administration

For the most part, solid waste management today is practiced much as it was in the past, i.e. transporting the waste to some sparsely populated area and dumping it. This system no longer works due to: the decrease of readily available land near large waste generating centers, much larger quantities of wastes to be disposed of, and increasingly stringent environmental protection standards.

Communities have faced their solid waste problems individually. Although this approach is inefficient, usually unsanitary, and uneconomical, it is still practiced today and indicates the complete lack of planning. The problem of solid waste disposal must be faced on a regional basis. Since this approach has not been a part of contemporary thinking, much work is needed to convince local authorities of the urgency of the problem and the need to develop regional solutions wherever possible. It is obvious that sound logical planning for solid waste management systems at all levels must be accelerated if new management systems are to evolve to cope with the rising problems.

The Federal role currently is providing technical assistance and funds to State, regional, and local groups to develop sound management plans. The future Federal role should include the funding of the implementation of these plans.

The solution to problems created by the increasing amount of solid waste being generated must ultimately rest with the local authorities and private organizations and funds must be committed to solve management problems at this level. Supporting funds from other sources must be provided to aid and stimulate these solutions.

Although a great deal of solid wastes are collected by contractors, many cities have little knowledge of who these people are; their capabilities; the kind of service they are providing and frequently exercise little or no control over these operations.

One of the greatest needs for improvement in solid waste management is for communities responsible for the regulation of solid wastes management to exercise proper control. Such control will assure fair and equitable competition in the private sector, provide adequate solid waste management for the public benefit, and place all solid waste management systems on an equal par.

Local and state government must establish desirable operational requirements for the management of solid wastes. At the present time, the role and interface of local government, private organizations and state government is neither understood nor defined. Management studies are needed to define the specific characteristics, etc. needed to provide for the proper management of commercial solid waste. The impacts of new and more comprehensive solid waste management systems must be understood.

The administration of solid waste systems by industry is usually, when the industry is large enough, the responsibility of plant engineering divisions. Where the size does not warrant or cannot support adequate plant engineering services, solid waste management becomes primarily a housekeeping chore with services, guidance, etc. provided by either community organizations or contract arrangement. The exact procedures, adequacy of these procedures, etc. are not known at the present time.

It would appear that solid waste management in industry like its counterparts in residential, commercial, etc. takes a poor third behind water and air pollution control. In most industries all "waste" handling is primarily conducted by the same personnel. Because industrial solid waste represents an unwanted material, the attitude of industry is basically the same as the private citizen, i.e. why waste money on something that apparently has no value? It is assumed that in many instances industry is not even aware of their actual solid waste management costs. This merely reflects again the overall national apathy about solid waste management.

Profit-oriented industry and industry management must develop a better understanding of the costs, problems, needs, etc. related to solid waste management. It is quite conceivable that if industries knew their solid waste management costs, new processes, reuse attempts, etc. would receive more than cursory examination. We need to develop more enlightened administrative methods to allow needed funding, manpower, facilities, etc. Further, these methods must place the highest priority on the incorporation of industrial and community systems. Studies are needed to identify current combined practices and examine the future feasibility of this approach.

The administration of agricultural solid waste practices is conducted almost solely on an individual operation basis. There have been a few systems attempting management on a cooperative basis in a restricted geographical area. These most often have been based on a utilization concept with profit as a motive and generally have been unsuccessful. The truly mutual coop-non-profit arrangement should be investigated. The proximity of the concentrated animal growing operations to the urban areas suggests an integrated urban-industrial-agricultural waste management concept, however, little experience has been reported in this area.

G.2. Legislation

Legislation is the responsibility of government, but industry strongly influences the course and nature of legislation. The legislative provision related to environmental protection has had profound effect in the past on the management of waste waters and atmospheric emissions. Current legislative trends are now pressing all sectors to follow more desirable practices in solid waste management. These trends are creating major problems where technology is limited to respond well to the new trends.

In many instances, present regulations prevent cooperation in solid waste management. Studies are needed to determine and understand the interrelationships of local, and state legislation, etc., community organizations; and industrial groups. These studies should provide insight into the development of new legislation that can provide for better management and control.

There is a lack of available information on solid waste legislation, but the **CPEHS/ECA solid waste program is presently collecting this** information.

Rural zoning that is permissive for selected agricultural operations and/or restrictive to non-farm housing and other activities is worthy of careful consideration. Planning and zoning to offer compatability between the urban-agricultural interface is sadly absent. Perhaps "rural renewal" and complete relocation of animal industry will be required.

In pesticide container management, the need for some form of responsibility designation is apparent. Perhaps the manufacturer must assume the responsibility for control, adequate financing and implementation of solid waste management practices.

Almost every community has ordinances dealing with solid waste management. Mostly these ordinances allow for funding of collection and disposal systems. Many communities have laws prohibiting improper storage or littering; but do not effectively enforce such regulations. Many of these ordinances present cooperative efforts with their neighbor.

States, for the most part, lack effective legislation dealing with solid waste management. States should pass legislation needed to facilitate the formation of regional solid waste districts, prohibit open burning and dumping, protect the environment against hazardous wastes (pesticides), and develop an active State solid waste program to provide needed services to the regional systems.

There is a need area for the development of model ordinances and laws which can be used as a guide for State and local governments. Until such work is done, it is feared that legislative action will remain a hodgepodge of ineffective laws with no real effect upon correcting unsanitary solid waste management practices. **The CPEHS/ECA solid waste program is presently working on such models.**

Industry continues to develop new products for American society. In many instances these new products create new wastes of significant variety and amount. At the present time, no legislation, etc. is directed at requiring industry to design into new products development waste management characteristics. Studies are needed to evaluate the feasibility of such legislation and the impact of such legislation on the economic growth and life of the United States. These studies should also consider the possibility of incentives, etc. provided to industry by government to provide products that are reclaimable or disposable or to provide necessary procedures to insure adequate management of the residue of their product. Through such studies direction should evolve for government and industry that will provide suitable management and cooperation through legislation, etc. in the future.

G.3. Financing

Communities have been unable or unwilling to spend the funds necessary for acceptable sanitary solid waste management systems. Even with more economical and regional approaches, greater investments are needed to resolve the mounting solid waste management problem. The source of these funds (Federal, State, or local) will have to be decided upon.

In the past, waste management systems have been financed with appropriations from the general tax revenues. The passage of municipal bonds has been used to finance specific facilities such as incinerators. But limitations on taxation and/or borrowing has caused a trend toward the fee method of financing.

The following is quoted from the 1968 National Survey:

> "The average community budget is approximately $1.42 per person per year for disposal activities, about one-sixth of which is for capital expenditures. For communities actually operating disposal systems, approximately $2.17 per person per year are expended, about one-third being for capital expenditures. For collection activities, the average budget for all communities in the country is $5.39 per person per year, with 10 percent going for capital expenditures.
>
> "The collection budgets for communities that actually operate their own systems are $5.60 per person per year for a once-a-week system and $6.82 per person per year for a twice-per-week system. From this we could conclude that twice-a-week collection costs only about 20 to 25 percent more than one-per-week collection."

Presently, solid waste management systems must compete for the limited funds available at the local level. The maximum return (benefit) for tax dollars accrues to the community which expends its resources in projects which are supported by State and Federal grants. Operating programs related to education, water, or air pollution control naturally receive priority because of their high degree of State and Federal funding. If we are to bring our solid waste disposal practices up to an acceptable level, State and Federal funds must become available.

There is a lack of uniform financial practices as well as a lack of an adequate cost accounting method for solid waste management subsystems. The maintenance of costs systems, development of sound funding principles, adequate and proper expenditure of funds, and planned investment recovery is almost nonexistent in today's solid waste management system. Identification of precise costs for various unit operations to properly assign operating, etc. design costs is not practiced. In many instances, generators of solid waste are not charged according to the amounts of solid waste placed in the system. Finally, solid waste management systems compete for the limited dollars available and place well down in the final results.

Studies, projects, efforts, etc. are needed to develop more fundamental financial practices for solid waste management. Ways to compete for the limited dollars more effectively are needed and more dollars are needed. Sound record keeping must be initiated at all levels. A uniform cost accounting system for sanitary landfills and incinerators has been developed by the CPEHS/ECA solid waste program and is now being tested and utilized by several communities throughout the United States.

The current financial involvement of industry in solid waste management is unknown. How industry finances its solid waste management system is not indicated. Information of a general and specific nature is needed if we are to assure both the protection of American industry and the environment. It may be that new financing procedures can be developed and applied that will encourage industry to invest heavily in solid waste management both for their own wastes and other wastes from the nonindustrial area. It is not inconceivable that an industry, dependent upon large quantities of energy, could economically and feasibly use combustible residential solid wastes for its raw energy source. This cooperative practice might reduce solid wastes processing costs for both participants while reducing the volume of wastes for disposal.

The primary aspect of financing that must be considered in the agricultural solid waste area is that solid waste management costs are legitimate and necessary and must be considered a part of the total production operation. The USDA is currently structured such that some form of support or incentive arrangement might be investigated. In agricultural operations--as in any industrial enterprise--the profit motive is paramount and what does not produce profit does not get financing.

G.4. Socio-Political-Economic Aspects

Solid waste is unattractive; people just do not want to think about it. As far as the general populous is concerned, the solid waste problem is putting their waste into their can and getting their can out to the curb where it can be collected. They could care less what happens to it after it leaves their curb.

Elected officials reflect the attitudes of their electorate. Public apathy means governmental apathy. If we are going to muster the fiscal resources needed to solve our massive solid waste problem, we must develop public concern for the problem. A comprehensive public information and education program is needed. We must "sell" the concept of proper solid waste management to the public.

Solid waste workers are at the bottom of the job-status ladder. The rapid turnover and usually high accident rate indicate the lack of job pride among solid waste employees. Collection crews have direct contact with the public; their job includes a great deal of public relations work. Emphasis should be placed on this aspect to raise employee moral and to help promote public concern.

However, public awareness and litter campaigns can be helpful in public-use activities (e.g. parks). A fee system is also a possible means of supporting adequate management in some institutions. For the long range solution one significant problem is the lack of strong incentives to produce packaging material and single use items designed for disposal or reclamation as well as for strength, aesthetics, and marketing appeal.

The attitude of citizens is an important key to improvement. In this vein, the unique opportunity in the military organization to enforce good housekeeping provides the basis for effective cost and motivational studies.

Although the major technical problems as now understood have been discussed in this plan, the socio-political-economic interface requires understanding. Because all sectors are partners in solid waste management systems, the impact on the socio-political-economic sector needs definition. Industry heavily influences government direction through political involvement. The significance of this involvement needs understanding. Further, the practices of industry on marketing, sales, etc. needs to be studied to determine if such practices have application in the solid waste management sector. The methods of employee incentive programs of industry may have application in helping solve the pressing manpower problems existing in solid waste management today. These methods need analysis and translation to solid waste management.

Certain obstacles within the socio-political-economic structure form a formidable barrier to improvement. Although improvements through research and development are a strong requirement--and should be obtainable--technology alone cannot bring about improved solid waste management in the agricultural sector. The problem areas are:

(1) Agricultural operations must be clearly recognized as a form of industry. The increasing size of successful agricultural efforts together with a highly mechanized, profit-oriented approach makes this concept more authentic.

(2) The costs of waste management must be recognized and borne by the industry generating the wastes. This recognition is not a part of the present situation.

(3) As alluded to earlier, the lack of advanced planning--including realistic zoning--brings the problems of agriculture closer to the urban sector. Improved technology and zoning are both needed.

(4) The use of cooperatives--successful in many agricultural product processing situations--has not been satisfactorily explored for waste management.

SOLID WASTE PROBLEM SOLUTIONS

Task Area A - Generation

Task Area B - Storage

Task Area C - Collection

Task Area D - Transport

Task Area E - Processing

Task Area F - Disposal

Task Area G - Management

General Statement

The proposed solutions to the problems of solid waste management are detailed by the flow pattern of the solid waste management matrix, i.e. generation, storage, collection, transport, processing, and disposal. The overall problems of management of complex solid waste systems is probed and proposals for the optimization of management systems is suggested. Where specific waste generators have unique problems requiring unique solutions, those solutions are identified by the waste sources.

Basically, the approach to the problem and the attendent solution is described by the classic approach of problem solving by the scientific community:

1. Quantification and qualification of the problem
2. Identification of possible solutions
3. Research, development, and demonstration of solutions
4. Implementation of optimal solutions

Coupled with the development of new solutions is the need for correction of existing problems with existing acceptable techniques. The problem solutions include, therefore, an aggressive program to upgrade, improve, or eliminate existing systems that must operate until such time that new solutions are available.

A great deal of the initial effort of the **CPEHS/ECA solid waste program has been in the quantification and qualification of solid** waste management problems. However, the surface has only been scratched and additional efforts are necessary to define the more complex problems not yet attacked. Indeed, a considerable portion of problem solutions are aimed at problem definition and solution orientation.

The solutions proposed, therefore, represent a comprehensive approach to "holding back the flood" by application of current acceptable technology while the CPEHS/ECA solid waste program develops new and/or improved methods of problem solutions.

SOLID WASTE PROBLEM SOLUTIONS

Task Area A - Generation

The best place to begin working on the solution to a problem is as near as possible to the source of the problem. Theoretically, if every item now being thrown away could either be reused or transformed to another physical form, we would not be faced with any solid waste disposal problems. This task area will investigate generative and qualitative characteristics of solid wastes to define the agents requiring management. This task will also provide the basis for improvement of existing subsystems and future subsystems.

Task Area A.1 Residential Solid Wastes

Task A.1.1

Title Determine Generation Rates of Residential Solid Waste

Objective To determine the current generation rates from residential sources; identify and evaluate the extent of the various problems created throughout the country by the generation of solid waste; to identify specific problems resulting from the generation of residential solid wastes; to explore other means of determining and evaluating the various problems created by the generation of solid wastes (input-output).

Schedule Initiate - Active Complete - FY 72

Task A.1.2

Title Determine Qualitative Characteristics of Residential Solid Waste

Objective To determine the physical characteristics of the components of the solid waste stream and establish some figures for the relative percent of each component present.

Schedule Initiate - Active Complete - FY 72

Task A.1.3

Title Reduce Residential Solid Waste Generation

Objective To investigate the packaging and other products present in residential solid waste and develop methods for reducing the overall amount of packaging and other products entering the solid waste stream.

Schedule Initiate - Active Complete - FY 73

Task A.1.4

Title Residential Solid Waste Data Feedback (Network)

Objective To establish a system that will provide a network for continuing updating of residential solid waste data in order to assess the effect of management, political, technological, etc. changes.

Schedule Initiate - FY 73 Complete - FY 75

Establish network in FY 73. Continuing operation will be required.

Task A.2 Commercial Solid Wastes

Task A.2.1

Title Determine Generation Rates for Each Commercial Group

Objective Obtain sufficient data to determine the quantity of commercial solid waste generated by major subcategories of wholesale, retail and service trades, etc. with relationships to the population area served. Project commercial growth and solid waste generation through the year 2000. Table 6 proposes scheduling of these studies.

Schedule Initiate - 1971 Complete - 1975

Task A.2.2

Title Commercial Solid Waste Generation Factors

Objective To relate quantities of commercial solid waste generated by major subcategories of wholesale, retail and service trades to factors that influence generation and develop predictive factors for each major commercial subcategory. (See Table 6)

Schedule Initiate - 1972 Complete - 1974

Task A.2.3

Title Commercial Solid Waste Quality Interrelationships

Objective To determine the social, economic, etc. interrelationships that exist between various major commercial subcategories and the impact such relationships have on commercial solid waste generated. As an example, in a shopping center the presence or absence of certain activities may influence the overall business activity of that center thereby influencing the commercial solid waste generation rate.

Schedule Initiate - 1973 Complete - 1975

Table 6

Schedule of Commercial

Solid Wastes

Generative Studies

SIC Division	Type	Major SIC Group	Intiate Study
Division F.	Wholesale and retail trade:		FY 71
	Wholesale trade	Major Group 50.	
	Building materials, hardward, and farm equipment dealers	Major Group 52.	
	Retail trade--general merchandise	Major Group 53.	
	Food Stores	Major Group 54.	
	Automotive dealers and gasoline service stations	Major Group 55.	
	Apparel and accessory stores	Major Group 56.	
	Furniture, home furnishings, and equipment stores	Major Group 57.	
	Eating and drinking places	Major Group 58.	
	Miscellaneous retail stores	Major Group 59.	
Division G.	Finance, insurance and real estate:		FY 72
	Banking	Major Group 60.	
	Credit agencies other than banks	Major Group 61.	
	Security and commodity brokers, dealers, exchanges, and services	Major Group 62.	
	Insurance carriers	Major Group 63.	
	Insurance agents, brokers, and service	Major Group 64.	
	Real estate	Major Group 65.	
	Combinations of real estate, insurance, loans, law offices	Major Group 66.	
	Holding and other investment companies	Major Group 67.	
Division H.	Services		FY 73
	Hotels, rooming houses, camps, and other lodging places	Major Group 70.	
	Personal services	Major Group 72.	
	Miscellaneous business services	Major Group 73.	
	Automobile repair, automobile services, and garages	Major Group 75.	
	Miscellaneous repair services	Major Group 76.	

SIC Division	Type	Major SIC Group	Intiate Study
Division H.	Services (con't)		
	Motion pictures	Major Group 78.	
	Amusement and recreation services, except motion pictures	Major Group 79.	
	Legal services	Major Group 81.	
	Educational services	Major Group 82.	
	Museums, art galleries, botanical and zoological gardens	Major Group 84.	
	Nonprofit membership organizations	Major Group 86.	
	Miscellaneous services	Major Group 89.	

Task A.2.4

Title Determine Commercial Solid Waste Qualitative Characteristics

Objective Determine through analyses, studies, etc., those characteristics and fractions that define the physical, chemical, etc. make-up of commercial solid waste produced by major subcategories of the wholesale, retail and service trades. (See Table 6).

Schedule Initiate - 1971 Complete - 1973

Task A.2.5

Title Factors Affecting Commercial Solid Waste Characteristics

Objective To determine the factors that affect the quality of each commercial solid waste produced by the major subcategories of the wholesale, retail and service trades.

Schedule Initiate - 1972 Complete - 1974

Task A.2.6

Title Commercial Development Trends

Objective Obtain through appropriate trade-off studies; marketing analyses, etc., the anticipated changes in commercial growth in order to project the changing characteristics and rates of commercial solid waste generated through the year 2000.

Schedule Initiate - 1972 Complete - 1975

Task A.2.7

Title Commercial Solid Waste Data Feedback

Objective To establish a feedback system that will provide continuing updating of commercial solid waste generative data in order to assess the effect of management, political, technologic, etc. changes.

Schedule Initiate - 1974 Complete - 1975

The system will be established. Continuing efforts will be needed to operate and update the operation.

Task A.3. Industrial Solid Waste

Task A.3.1

Title Determine Generation Rates for Each SIC Code

Objective Obtain sufficient data to determine amounts of industrial solid wastes generated by each SIC Code. Project industrial growth and solid waste generation through the year 2000.

Current Work Limited studies are now active in the following SIC Codes or Subcodes:

Polymer
Automotive
Food Processing
Rubber
Drug
Printing and Publishing
Industrial Chemical
Electrical Home Appliance

Schedule Initiate - Active Complete - FY 75

Studies in each SIC Code are scheduled as illustrated in Table 7.

Table 7

SCHEDULE OF INDUSTRIAL SOLID WASTE GENERATIVE STUDIES

Industry	SIC Code	FY Intiate
Lumber	24	70
Paper	25	71
Building Construction	15	71
Construction other than buildings	16	71
Construction - Special Trade	17	71
Chemical (Complete initial Studies)	27	72
Petroleum	29	72
Food (Complete initial studies)	32	72
Primary Metals	33	72
Fabricated Metal Products	34, 35	72
Textiles	22	73
Apparel	23	73
Furniture & Fixtures	25	73
Leather & leather products	31	73
Electrical machinery (Complete initial studies)	36	74
Transportation Equipment (Complete initial studies)	37	74
Ordnances	19	74
Instrument	38	74
Miscellaneous	39	75

Note: All Industrial Solid Waste Studies will consider these groups in this order.

Task A.3.2

Title Generation Rates Related to Process Lines

Objective Determine generation rates and source point of solid wastes from industrial process lines (Companion Task to Task A.3.1.)

Current Work See Task A.3.1.

Schedule See Task Area A.3.1. Complete - FY 75
(Table 7)

Task A.3.3

Title Prediction Factors for Industrial Solid Waste Generation

Objective Develop factors that will allow the prediction of solid waste generation from the various SIC Codes, point sources of portions of a process line, and for subcodes within the SIC Codes (Companion Task to Task A.3.1.)

Current Work See Task A.3.1.

Schedule See Task A.3.1., Table 7

Complete See Task A.3.1.

Task A.3.4.

Title Reduce Industrial Solid Waste Generation

Objective To conduct studies, analyses, etc. of various individual industrial processes in order to develop where possible and if possible methods of reducing industrial solid waste generation at the source.

Current Work None

Schedule Initiate FY 72

Complete Continuing efforts to reflect industrial technology changes. Maximum number of studies will be accomplished that will provide insight into which industries may achieve significantly reduce generation of solid waste at the source by the end of FY 75.

Task A.3.5

Title Characteristics of Industrial Solid Waste

Objective Determine through analysis, studies, etc. those characteristics that define the physical, etc. makeup of industrial solid waste from each SIC Code. In certain instances new/modified analytical procedures may need to be developed to adequately characterize the generated industrial solid waste. Many generated solid waste characteristics are now known, but only in general, nonquantified terms, e.g. "goop". Valid, accurate and translatable characteristics of industrial solid waste are needed to aid in preventing wastage of valuable resources. Preliminary efforts in this area are being done in the studies described in Task A.3.1.

Schedule Initiate - FY 71

Complete Meaningful results on current industrial solid waste can be expected by end of FY 75. Continuing work will be required to affect new solid waste generated.

Task A.3.6

Title Industrial Development Trends

Objective Obtain, through trade off studies, marketing analyses, technological surveys, etc., the anticipated changes in industrial growth and process techniques in order to project, within reasonable limits, changing character and rates of industrial solid waste generated through the year 2000. Computer technology coupled with advanced systems analysis can be a most valuable tool for predictive science. This study can do much to indicate the growth and magnitude of future technological, socio-political, and other industrial solid waste generation problems.

Schedule Initiate - FY 71 Complete - FY 75

Task A.3.7

Title Industrial Solid Waste Data Feedback (Network)

Objective To establish a feedback system that will provide continuing updating of industrial solid waste generative data in order to assess the effect of management, political, social, financial, and technological changes.

Schedule Initiate - FY 74 Complete - FY 75 will see the system established. Continuing efforts will be needed to operate and update the operation.

Task A.4. Agricultural Solid Wastes

Task A.4.1.

Title Agricultural Solid Waste Generative Characteristics

Objective Develop generation information on the amounts and distribution of agricultural solid wastes

Schedule Initiate - FY 72 Complete - FY 74

Task A.4.2.

Title Agricultural Solid Waste Categorization

Objective Develop a more precise category and quality definition of agricultural solid wastes.

Schedule Initiate - FY 72 Complete - FY 74

Task A.4.3.

Title Agricultural Solid Waste Reduction

Objective Explore the feasibility and mechanisms to reduce the amounts of agricultural solid waste generated.

Schedule Initiate - FY 73 Complete - Unknown at this time

Task A.5. Institutional Solid Wastes

Task A.5.1.

Determine the present generation rates and characteristics of solid wastes from representative institutions. Determine quantities and characteristics of wastes from different sources; identify and evaluate public health hazards and other environmental aspects; determine present direct and indirect costs and benefits; develop generative predictive factors; determine salvage practices; and study and assess management practices.

Schedule Initiate - 1971 Complete - 1975

Projects on each institutional group will proceed as described in Table 8.

Table 8

Schedule of Institutional Solid Wastes Generative Studies

Institutional Source	Initiate Study
1. Hospitals	FY 71
2. Military bases and administrative facilities	FY 71
3. Military research and development and manufacturing facilities	FY 71
4. Schools, colleges, and universities	FY 72
4. Governmental administrative facilities (City hall, Capitol, etc.)	FY 72
4. Governmental utilities or manufacturing facilities (NASA, TVA, AEC)	FY 73
5. Prisons and other penal institutions - including mental hospitals and nursing homes.	FY 73
5. Laboratory and research and development facilities.	FY 73
5. Recreational (non-profit) facilities. (parks, beaches, libraries)	FY 73

Task Area B - Storage

Under current solid waste management practices, the storage subsystem for solid wastes provides the greatest public exposure to the waste material. Solid wastes generally remain on the premises for varying periods of time, providing an opportunity not only for frequent human contact, but if stored improperly, for disease vectors (flies, rats, etc.) to feed and multiply. The primary objective of this task area is to investigate and define current storage techniques and develop more efficient solid wastes storage subsystems to minimize the costs of those subsystems; and optimize the interface with the rest of the system.

Task B.1. Residential Solid Wastes

Task B.1.1.

Title Residential Waste Storage Practices

Objective To determine existing residential solid waste storage practices through the conduct of block surveys in selected communities in the nation.

Schedule Initiate - 1971 Complete - 1973

Task B.1.2.

Title Evaluation of Residential Waste Storage Practices

Objective To evaluate the adequacy of residential solid waste storage practices through the conduct of vector (fly, rodent, etc.) studies, economic and other analyses, including but not limited to general climatic, geography and administrative factors and to relate these factors to the storage practices determined under subtask.

Schedule Initiate - 1971 Complete - 1973

Task B.1.3.

Title Residential Solid Waste Storage Determinants

Objective To determine the major determinants, such as time, temperature, organic matter, etc. of the vector-attractive and nuisance-evident characteristics of stored residential wastes.

Schedule Initiate - 1971 Complete - 1973

Task B.1.4.

Title Pyscometry of Residential Solid Waste Storage

Objective To define, assess and evaluate human factors and attitude affecting and determining residential waste storage practices.

Schedule Initiate - 1971 Complete - 1973

Task B.1.5.

Title Residential Waste Storage Guidelines

Objective To utilize current knowledge and information generated under task area to develop guidelines for acceptable residential waste storage practices.

Schedule Initiate - 1972 Complete - 1975

Task B.1.6.

Title Residential Waste Container and Container--Substitute Development

Objective To develop and evaluate containers and substitute systems for storing residential wastes to attain or exceed prescribed performance levels for health, durability, economy, aesthetics, convenience and other related factors.

Schedule Initiate - 1970 Complete - 1978

Task B.1.7.

Title Residential Waste Pre-Storage Processing

Objective To develop and evaluate pre-storage practices and processes that can have beneficial effects in increasing storage performance factors such as health, economics, aesthetics, convenience, etc.

Schedule Initiate - 1970 Complete - 1978

Task B.1.8.

Title Residential Waste Storage and Treatment Development and Evaluation

Objective To develop and evaluate non-mechanical residential waste treatment, such as deodorizing, disinfecting, heating, etc. to increase storage performance factors such as health, economics, aesthetics, convenience, etc.

Schedule Initiate - 1970 Complete - 1978

Task B.2. Commercial Solid Wastes

Task B.2.1.

Title Determine Commercial Solid Waste Storage Subsystems

Objective Obtain sufficient data through surveys, studies, etc., to determine current storage practices for all major subsystems of commercial enterprises.

Schedule Initiate - 1971 Complete - 1975

Task B.2.2.

Title Evaluate Commercial Solid Waste Storage Subsystems

Objective Conduct studies, etc. to evaluate the efficiency, reliability, etc. of current commercial solid waste storage subsystems and the costs associated with each subsystem. Results of this task will provide the necessary information on what subsystems are acceptable for current application, and will indicate areas of research and development effort for new and improved subsystems.

Schedule Initiate - 1971 Complete - 1974

Major efforts achieved by the end of FY 74. Continuing efforts will be needed to account for new and different commercial solid waste.

Task B.2.3.

Title Development of New or Improved Commercial Solid Waste Storage Subsystems

Objective Based upon the results of Tasks, initiate a research and development program to develop new or improved storage subsystems where needed for each commercial subcategory. New subsystems must consider the need for salvage, reuse, etc. and might involve rigid or flexible containers, new stationary compaction concepts, etc.

Schedule Initiate - 1973 Complete - Unknown at this time

Task B.2.4.

Title Demonstrate New or Improved Commercial Solid Waste Storage Subsystems

Objective Depending on the results and other knowledge provide necessary technical and financial assistance (grants, loans, tax incentives, etc.) to public and private agencies to demonstrate new or improved storage subsystems at the commercial and/or governmental level.

Schedule Initiate - FY 74

Complete - This effort because of its magnitude and complexity does not allow for a completion by FY 75. A well ordered program should be active by FY 78-9.

Task B.2.5.

Title Upgrade Existing Storage Subsystems

Objective To provide technical and financial assistance to upgrade existing subsystems by the application of known acceptable technology such as better regulations for storage; use of compaction equipment; use of disposable storage units, etc.

Schedule Initiate - FY 71

Complete - FY 75 should see the end of the major efforts using existing technology. New methods will be available requiring dissemination.

Task B.2.6.

Title Commercial Solid Waste Storage Standards

Objective To establish and promote standards of design and operation of commercial solid waste storage methods. If promotional work fails, then enforcement efforts will be required.

Schedule Initiate - FY 73 Complete - Continuing

Task B.3. Industrial Solid Wastes

Task B.3.1.

Title Determine Current Industrial Solid Waste Storage Subsystems

Objective Obtain sufficient data through surveys, studies, analyses, etc. to determine current industrial solid waste storage practices for all SIC Codes. Major emphasis will be placed on those solid waste characteristics that significantly effect storage practices.

Schedule Initiate - Active Complete - FY 75

Task B.3.2.

Title Evaluate Industrial Solid Waste Storage Subsystem

Objective Conduct analyses, etc. to evaluate the efficiency, acceptability of current industrial solid waste storage practices and the cost associated with each practice. Evaluation criteria will need to be developed for many of the industries to be studied. Results of the evaluations will indicate areas requiring research and development of new storage subsystems.

Schedule Initiate - Active

Complete - Major objectives reached by end of FY 74. Continuing efforts to account for new industrial solid waste generated.

Task B.3.3.

Title Development of New or Improved Industrial Solid Waste Storage Subsystems

Objective Following identification and evaluation of current storage subsystems and a determination of future needs (Tasks B.3.1. & B.3.2.) initiate a research and development program to develop new or improved storage subsystems, where needed for each SIC Code. New storage subsystems might involve either rigid or flexible containers; readily disposable or reusable containers; new ways to extend storage life without adverse environmental effects; structural or chemical transformation while stored, etc.

Schedule Initiate - FY 71

Complete - FY 75 Major objectives reached by the end of FY 75. Continuing efforts to account for new industrial technology.

Task B.3.4.

Title Demonstrate and Implement New or Improved Industrial Solid Waste Storage Subsystems

Objective Depending on the results of Task B.3.3. and other technology, provide necessary technical and financial assistance (grants, contracts, tax incentives, etc.) to public and private agencies to demonstrate and implement new or improved storage subsystems at the industrial and/or government level of solid waste management.

Schedule Initiate - FY 73

Complete - The magnitude of the suggested effort will not permit orderly and well managed completion by end of FY 75. A well structured program should continue through FY 78, with reduced effort thereafter continuing.

Task B.3.5.

Title Upgrade Existing Storage Subsystems

Objective To provide technical and financial assistance to upgrade existing industrial solid waste storage subsystems by the application of known acceptable technology such as conversion to a containerized subsystem; standardization of types of containers; implementation of uniform storage procedures; etc. Acceptable technology is available now - the dissemination of information and resources to upgrade current practices is needed.

Schedule Initiate - FY 71

Complete - FY 75 should see the completion of the major portion of this effort. By that time new methods will require dissemination to industry and government.

Task B.3.6.

Title Industrial Solid Waste Storage Standards

Objective To establish and promote standards of design and operation for all industrial solid waste storage methods. If promotional work does not succeed in attaining the standards, the enforcement efforts will be required.

Schedule Initiate - FY 72 Complete - Continuing

Task B.4. Agricultural Solid Wastes

(Also Tasks C.4. & D.4.)

Tasks B.4., C.4., D.4.

Title Storage Collection and Transport of Agricultural Solid Wastes

Objective To improve storage collection and transport of: (1) animal wastes, (2) crop and forest waste and (3) pesticide wastes.

Subtask B.C.D.4.1.

Development of concepts for the obtaining of new technology to provide adequate storage, collection and transport of animal, crop and forest wastes consonant with new systems for processing and disposal of such wastes.

Schedule Initiate - 1973 Complete - 1975

Subtask B.C.D.4.1.

Determine, develop and test the optimum system for transporting, collecting and storing wastes pesticide materials and associated containers which is consonant with the optimum processing and disposal systems for these items.

Schedule Initiate - 1973 Complete - 1975

Task B.5. Institutional Solid Wastes

Task B.5.1.

Title Determine Institutional Solid Wastes Storage Subsystems

Objective Obtain sufficient data through surveys, studies, etc., to determine current storage practices for all major subsystems of institutional sources.

Schedule Initiate - 1971 Complete - 1975

Task B.5.2.

Title Evaluate Institutional Solid Waste Storage Subsystems

Objective Conduct studies, etc. to evaluate the efficiency, reliability, etc. of current institutional solid waste storage subsystems and the costs associated with each subsystem. Results of this task will provide the necessary information on what subsystems are acceptable for current application, and will indicate areas of research and development effort for new and improved subsystems.

Schedule Initiate - 1971 Complete - 1974

Major efforts achieved by the end of FY 74. Continuing efforts will be needed to account for new and different institutional solid wastes.

Task B.5.3.

Title Development of New or Improved Institutional Solid Wastes Storage Subsystems

Objective Based upon the results of Tasks B.5.1. and B.5.2 , initiate a research and development program to develop new or improved storage subsystems where needed for each institutional source. New subsystems must consider the need for salvage, reuse, etc. and might involve rigid or flexible containers, new stationary compaction concepts, etc.

Schedule Initiate - 1973 Complete - Unknown at this time

Task B.5.4.

Title Demonstrate New or Improved Institutional Solid Wastes Storage Subsystems

Objective Depending on the results of B.5.3. and other technology, provide necessary technical and financial assistance (grants, loans, tax incentives, etc.) to public and private agencies to demonstrate new or improved storage subsystems at the institutional and/or governmental level.

Schedule Initiate - FY 74

Complete - This effort because of its magnitude and complexity does not allow for a completion by FY 75. A well ordered program should be active by FY 78-9.

Task B.5.5.

Title Upgrade Existing Storage Subsystem

Objective To provide technical and financial assistance to upgrade existing subsystems by the application of known acceptable technology such as better regulations for storage; use of compaction equipment; use of disposable storage units, etc.

Schedule Initiate - FY 71

Complete - FY 75 should see the end of the major efforts using existing technology. New methods will be available requiring dissemination.

Task B.5.6.

Title Institutional Solid Wastes Storage Standards

Objective To establish and promote standards of design and operation of institutional solid wastes storage methods. If promotional work fails, the enforcement efforts will be required.

Schedule Initiate - FY 73 Complete - Continuing

Task Area C - Collection

Solid waste collection technology has not significantly changed in the past 25 years. It is assumed that collection subsystems are significantly influenced by the generator, waste character, storage method and organizational attitude. This task area assesses and evaluates current collection subsystems; determines the need for future collection subsystems; proposes developmental efforts for future collection subsystems; provides for methods of implementation of new collection subsystems; and upgrades existing subsystems through the application of acceptable existing technology.

Task C.1. Residential Solid Wastes

Task C.1.1.

Title Determine and Evaluate Current Residential Solid Wastes Collection Subsystems

Objective To determine present collection practices in the country; to determine the costs of these systems and identify areas for improvement.

Schedule Initiate - FY 69 Complete - FY 72

Task C.1.2.

Title Develop New or Improved Residential Solid Wastes Collection Subsystems

Objective To develop new and/or improved collection subsystems for residential solid waste.

Due to the large areas, dissimilar conditions and special situations involved in most collection routes, it is impossible to develop highly sophisticated collection equipment. Equipment is required that is efficient, versatile, and reliable. Based on the results of Task C.1.1, projects proposed for this task will range from improving existing equipment to developing entirely new methods and equipment, such as new mechanical subsystems; special subsystems for bulky solid waste; pneumatic subsystems, etc.

Schedule Initiate - FY 71

Complete - FY 75 Continuing efforts beyond FY 75 to meet changing wastes, needs, technology, etc.

Task C.1.3.

Title Upgrade Existing Residential Collection Subsystems

Objective To provide technical and financial assistance, etc. to upgrade existing residential solid waste collection subsystems through the application of existing acceptable technology.

Schedule Initiate - FY 71 Complete - FY 75

Task C.1.4.

Title Residential Solid Waste Collection Subsystems Standards

Objective To develop and promote standards for the design and operation of residential solid waste collection subsystems. If promotional activities fail, then enforcement efforts will be necessary.

Schedule Initiate - FY 72 Complete - FY 75

Task C.2. Commercial Solid Wastes

Task C.2.1.

Title Determination of Current Status of Commercial Solid Waste Collection Subsystems

Objective To obtain fundamental data necessary on manpower expended; equipment types and the manner in which they are used; types of waste collected; frequenty of service; types of records available; in-house collection procedures, accident and injury records; private versus public collection and the cost associated with these factors for major subcategories of commercial solid waste. The data will provide a technological base for evaluation of the current status of commercial waste.

Schedule Initiate - 1971 Complete - 1975

Task C.2.2.

Title Evaluate Commercial Solid Waste Collection Subsystems

Objective Conduct analyses, etc. to evaluate the efficiencies, acceptability, costs, etc. of current subsystems and technology; determine future needs in collection methods, equipment, manpower and determine research and development needs. Results of this task will determine the efforts in Task C.2.3.

Schedule Initiate - 1972 Complete - 1975

Task C.2.3.

Title Development of New or Improved Commercial Solid Waste Collection Subsystems

Objective Based on the results of Task C.2.2., initiate a program to develop new or improved collection subsystems such as mechanical, hydraulic, etc. for the commercial subcategories where needed. Efforts will be directed toward reduction of commercial solid waste needing collection; the development of automatic on-site collection subsystems; and shopping center collection subsystem optimization.

Schedule Initiate - 1973

Complete - FY 75 Major technology and subsystems development will be accomplished by the end of FY 75. Efforts will continue beyond FY 75 to accommodate new commercial changes and commercial solid waste.

Task C.2.4.

Title Demonstrate and Implement Improved Commercial Solid Waste Collection Subsystems

Objective Depending upon the results of Task C.2.3. and other technology, provide the necessary financial and technical assistance (grants, contracts, tax incentives, etc.) to public and private agencies to demonstrate and implement new developed or improved collection subsystems.

Schedule Initiate - 1973 Complete - Continuing

Task C.2.5.

Title Upgrade Existing Collection Subsystem

Objective To provide assistance, etc. to upgrade existing collection subsystems by the application of known acceptable technology such as centralized subsystems for shopping centers, the installation of pneumatic collection subsystems in office buildings, etc.

Schedule Initiate - FY 71 Complete - Continuing

Task C.2.6.

Title Commercial Solid Waste Collection Standards

Objective To establish and promote standards of design and operation for commercial solid waste collection subsystems. If promotional work does not succeed in attaining standards, then enforcement efforts will be required.

Schedule Initiate - FY 72 Complete - Continuing

Task C.3. Industrial Solid Wastes

Task C.3.1.

Title Determination of Current Industrial Solid Waste Collection Subsystems

Objective To obtain data and information on the current collection subsystem used for industrial solid waste. This will include types, amounts of wastes going to each type, etc.

Schedule Initiate - Active Complete - FY 75
Task A.3. See Task A.3.

Task C.3.2.

Title Evaluate Industrial Solid Waste Collection Subsystems

Objective Conduct analyses, etc. to evaluate the efficiencies, acceptability of current subsystems and technology, the current costs for these practices; and determine future needs in collection methods, equipment manpower, degree of technology and systems. Results of this task will determine the direction of Tasks C.3.3., C.3.4., and C.3.5.

Schedule Initiate - Active Complete - FY 75
See Task A.3. See Task A.3.

Task C.3.3.

Title Development of New or Improved Industrial Solid Waste Collection Subsystems

Objective Based on the results of Task C.3.1. and C.3.2.

initiate a program to develop a new or improved collection subsystems such as mechanical, pneumatic, hydraulic, vehicular, etc. for SIC Codes where needed. The magnitude of the current industrial solid waste may be measurably reduced if new methodology can be developed. Automated collection has the potential of forcing segregation of wastes and thereby enhancing recycling/reuse. Additionally, improved collection techniques may overcome hazardous conditions (e.g. hand handling of chemical wastes vs. pneumatic collection).

Schedule Initiate - FY 71 Complete - FY 75

Continue beyond FY 75 to accommodate new industrial solid waste and industrial changes. Major technology and subsystems development will be accomplished by the end of FY 75.

Task C.3.4.

Title Upgrade Existing Collection Subsystems

Objective To provide technical and financial assistance, etc. to upgrade existing collection subsystems by the application of known acceptable technology such as use of compaction vehicles; initiation of a regular schedule collection program; use of pneumatic conveyance; use of hydraulic system; complete collection from a central service system; etc.

Schedule Initiate - FY 71 Complete - Continuing

Task C.3.5.

Title Industrial Solid Waste Collection Standards

Objective To establish and promote standards of design and operation for all industrial solid waste collection systems. If promotional work does not succeed in attaining standards, then enforcement efforts will be required.

Schedule Initiate - FY 72 Complete - Continuing

Task C.4. Agricultural Solid Wastes

See Task B.4.

Task C.5. Institutional Solid Wastes

Task C.5.1.

Title Determine Institutional Solid Wastes Collection Subsystems

Objective Obtain sufficient data through surveys, studies, etc., to determine current collection practices for all major subsystems of institutional sources.

Schedule Initiate - 1971 Complete - 1975

Task C.5.2.

Title Evaluate Institutional Solid Waste Collection Subsystems

Objective Conduct studies, etc. to evaluate the efficiency, reliability, etc. of current institutional solid waste collection subsystems and the costs associated with each subsystem. Results of this task will provide the necessary information on what subsystems are acceptable for current application, and will indicate areas of research and development effort for new and improved subsystems.

Schedule Initiate - 1971 Complete - 1974

Major efforts achieved by the end of FY 74. Continuing efforts will be needed to account for new and different institutional solid wastes.

Task C.5.3.

Title Development of New or Improved Institutional Solid Wastes Collection Subsystems

Objective Based upon the results of Tasks C.5.1. and C.5.2., initiate a research and development program to develop new or improved collection subsystems where needed for each institutional source. New subsystems must consider the need for combined subsystems, use of pneumatic and hydraulic principles, elimination of contamination potential, etc.

Schedule Initiate - 1973 Complete - Unknown at this time

Task C.5.4.

Title Demonstrate New or Improved Institutional Solid Wastes Collection Subsystems

Objective Depending on the results of C.5.3 and other technology, provide necessary technical and financial assistance (grants, loans, tax incentives, etc.) to public and private agencies to demonstrate new or improved collection subsystems at the institutional and/or governmental lewel.

Schedule Initiate - FY 74

Complete - This effort because of its magnitude and complexity does not allow for a completion by FY 75. A well ordered program should be active by FY 78-9.

Task C.5.5.

Title Upgrade Existing Collection Subsystems

Objective To provide technical and financial assistance to upgrade existing subsystems by the application of known acceptable technology such as better regulations for collection; use of automated equipment; use of centralized storage subsystems, etc.

Schedule Initiate - FY 71

Complete - FY 75 should see the end of the major efforts using existing technology. New methods will be available requiring dissemination.

Task C.5.6.

Title Institutional Solid Wastes Collection Standards

Objective To establish and promote standards of design and operation of institutional solid waste collection methods. If promotional work fails, then enforcement efforts will be required.

Schedule Initiate - FY 73 Complete - Continuing

Task Area D - Transport

Transport and collection are frequently inseparable in solid waste management systems. As systems tend toward combination and regionalization, transport of solid wastes will become a greater factor in the overall management network. This task will determine the current transport efforts, techniques and subsystems; evaluate these subsystems; identify areas requiring new technology; prepare research and development efforts to provide the needed new technology; provide for methods of demonstrating and implementing the new subsystems developed; and upgrade existing transport subsystems through the application of acceptable existing technology.

Task D.1. Residential Solid Wastes

Task D.1.1

Title Residential Solid Waste Transport Problem Definition and Evaluation

Objective To survey, assess and evaluate contemporary residential solid waste transport practices. This activity is a necessary pre-requisite to establishing standards and to developing techniques and practices that lead to more efficient (technologically, economically, aesthetically, healthful, etc.) transport systems. Recommended areas for new development will be proposed to guide the research and development efforts.

Schedule Initiate - FY 71 Complete - FY 75

Task D.1.2.

Title Development of New or Improved Residential Solid Waste Transport Subsystems

Objective To apply knowledge and information generated from Task D.1.1. to develop new techniques, equipment, etc. in residential solid waste transport. Examples of subtasks would be:

1. Pre-transport subprocessing
2. New vehicular transport methods
3. Waterway transports
4. Pipeline transport
5. Air transport

Schedule Initiate - FY 71 Complete - Continuing

Major efforts will be affected by the end of FY 75 in order to optimize new solid waste management systems. Further work will continue to reflect changing wastes, needs, etc.

Task D.1.3.

Title Upgrade Existing Transport Subsystems

Objective To provide technical and financial assistance, etc. to upgrade existing subsystems through the application of acceptable available technology.

Schedule Initiate - FY 71 Complete - FY 75

Task D.1.4.

Title Residential Solid Waste Transport Standards

Objective To develop and promote standards of design and operation for residential waste transport subsystems.

Schedule Initiate - FY 71 Complete - FY 74

Task D.2. Commercial Solid Wastes

Task D.2.1.

Title Survey and Evaluate Existing Commercial Solid Waste Transport Subsystems

Objective To obtain data and information of current transport methods; evaluate these methods and determine needs for future subsystems.

Schedule Initiate - FY 71 Complete - FY 73

Task D.2.2.

Title Development of New or Improved Commercial Solid Waste Transport Systems

Objective Based upon the results of Task D.2.1. initiate a program to develop new or improved transport subsystems for each commercial subcategory as needed. Examples of new subsystems might be an integrated pneumatic system for an entire shopping center, etc.

Schedule Initiate - FY 73 Complete - Continuing

Task D.2.3.

Title Demonstrate and Implement New or Improved Commercial Solid Waste Transport Subsystems

Objective Depending upon the results of Task D.2.2. and other technology, provide the necessary technical and financial assistance (grants, contracts, tax incentives, personnel, etc.) to public and private agencies to demonstrate and implement newly developed or improved transport subsystems. An example might be the installation of a central transport subsystem in a shopping center to demonstrate to commercial enterprises and real estate developers and communities the efficiency, etc. of such a subsystem.

Schedule Initiate - FY 74 Complete - Continuing

Task D.2.4.

Title Upgrade Existing Transport Subsystems

Objective To provide assistance, etc. to upgrade existing transport subsystems by the application of known acceptable technology.

Schedule Initiate - FY 71 Complete - Continuing

Task D.2.5.

Title Commercial Solid Waste Transport Subsystem Standards

Objective To establish and promote standards of design and operation of commercial solid waste transport subsystems. If promotional work does not succeed in attaining standards, then enforcement efforts will be required.

Schedule Initiate - FY 72 Complete - Continuing

Task D.3. Industrial Solid Wastes

Task D.3.1.

Title Current Industrial Solid Waste Transport Subsystems

Objective To obtain data and information on the current transport subsystems used for industrial solid waste including types, wastes transported by each type, cost per unit transported, etc.

Schedule Initiate - Active Complete - FY 75

See Task A.3. See Task A.3.

Task D.3.2.

Title Evaluate Industrial Solid Waste Transport Subsystems

Objective Conduct analyses, etc. to evaluate the efficiencies, acceptability, applicability of current practices; determine costs related to these practices; and determine the needs for new methods, equipment and systems. Results of this task will determine efforts in Task

Schedule Initiate - Active Complete - Continuing

See Task A.3.

Task D.3.3.

Title Development of New and Improved Industrial Solid Waste Transport Subsystems

Objective Based upon the results of Task D.3.2., initiate a program to develop new or improved, efficient, and economical transports subsystems for the SIC Codes as needed. Examples of new subsystems could include such transport methods as pneumatic, hydraulic, vehicular, or others not presently envisioned. Long distance pipeline transport of industrial sludges, etc. will be given special study.

Schedule Initiate - FY 71 Complete - See Task B.3.3.
B.2.3.

Task D.3.4.

Title Demonstrate and Implement New or Improved Industrial Solid Waste Transport Subsystems

Objective Depending upon the results of Task D.3.3. and other technology, provide the necessary technical and financial assistance (grants, contracts, tax incentives, etc.) to public and private agencies to demonstrate and implement new or improved transport subsystems. Examples might be a regional pipeline transport system to transport all industrial solid waste from a metropolitan area to a central processing and disposal facility.

Schedule Initiate - FY 74 Complete - See Task B.3.4.

Task D.3.5.

Title Upgrade Existing Transport Subsystems

Objective To provide technical and financial assistance to upgrade existing industrial solid waste transport subsystems by the application of known acceptable technology, such as use of transfer stations; use of transfer vans; installation of hydraulic systems; process adjustment to reduce or eliminate the need for transport, etc.

Schedule Initiate - FY 71 Complete - See B.3.5.

Task D.3.6.

Title Industrial Solid Waste Transport Standards

Objective To establish and promote standards of design and operation for all industrial solid waste transport methods. If promotional work does not succeed in attaining the standards, then enforcement efforts will be required.

Schedule Initiate - FY 72 Complete - Continuing

Task D.4. Agricultural Solid Wastes

See Task B.4.

Task D.5. Institutional Solid Wastes

Task D.5.1.

Title Current Institutional Solid Wastes Transport Subsystems

Objective To obtain data and information on the current transport subsystems used for institutional solid wastes including types, wastes transported by each source, cost per unit transported, etc.

Schedule Initiate - FY 71 Complete - FY 75

Task D.5.2.

Title Evaluate Institutional Solid Wastes Transport Subsystems

Objective Conduct analyses, etc. to evaluate the efficiencies, acceptability, applicability of current practices; determine costs related to these practices; and determine the needs for new methods, equipment and systems. Results of this task will determine efforts in Task D.5.3.

Schedule Initiate - FY 71 Complete - Continuing

Task D.5.3.

Title Development of New and Improved Institutional Solid Wastes Transport Subsystems

Objective Based upon the results of Tasks D.5.1. and D.5.2. initiate a program to develop new or improved, efficient, and economical transport subsystems for the sources as needed. Examples of new subsystems could include such transport methods as pneumatic, hydraulic, vehicular, or others not presently envisioned. Long distance pipeline transport of contagious wastes, etc. will be given special study.

Schedule Initiate - FY 71 Complete - See Task B.3.3.

Task D.5.4.

Title Demonstrate and Implement New or Improved Institutional Solid Waste Transport Subsystems

Objective Depending upon the results of Task D.5.3. and other technology, provide the necessary technical and financial assistance (grants, contracts, tax incentives, etc.) to public and private agencies to demonstrate and implement new or improved transport subsystems. Examples might be a regional systems to transport all hospital solid wastes to a central processing and disposal facility.

Schedule Initiate - FY 74 Complete - See B.3.4.

Task D.5.5.

Title Upgrade Existing Transport Subsystems

Objective To provide technical and financial assistance to upgrade existing institutional solid waste transport subsystems by the application of known acceptable technology, such as use of transfer stations; use of transfer vans; installation of hydraulic systems; process adjustment to reduce or eliminate the need for transport, etc.

Schedule Initiate - FY 71 Complete - See B.3.5.

Task D.5.6.

Title Institutional Solid Waste Transport Standards

Objective To establish and promote standards of design and operation for all institutional solid waste transport methods.

If promotional work does not succeed in attaining the standards, then enforcement efforts will be required.

Schedule Initiate - FY 72 Complete - Continuing

Task Area E - Processing

The answer to the solid waste management problem ultimately must include methods to transform the solid waste into a useable commodity which can enter the economy in a different form. This area has not been studied as thoroughly as have the solid waste management areas involving conventional disposal techniques. In order to conserve the country's resources, this negligence has been terminated and funds are now being provided for projects in the processing area.

Developments in on-site processing of commercial solid waste could offer tremendous benefits in waste reduction and in the salvage and recycle of commercial solid wastes.

It would appear that (because the material is largely putrescible in nature) much of the restaurant and market wastes which now must be given special handling and collection could be ground and flushed into sanitary sewers for treatment at sewage treatment plants. However, we do not know the effects of such processes on sewer systems should such practices gain widespread application.

A good deal of industrial solid wastes are presently processed for reuse, recycling, reclamation, or preparation for final disposal. Processing may be done to provide reuse within the host industry, or as a raw material for a recipient industry.

This task area will determine the current processing methods used; the existing levels of processing technology and technology needs; the wastes that are channeled through each process; the efficiencies, etc. of each process utilized; determine the needs and types of new processing techniques; assess the impact of such processes on the economic base of the country; develop new process subsystems; provide for methods of demonstrating and implementing those processing subsystems developed that offer the greatest possibility of cost/benefit and technology achievement; and improve existing subsystems, worthy of modification, to acceptable levels of operation, etc.

Since the application of the processing unit, operation will cross all wastes streams and be utilized by all management systems; this section of the plan will not differentiate between various waste sources. It is implied in the task statements that all waste sources will be studied and application of the processes will be focused on all of these waste sources.

Task E.1.

Title Survey and Evaluation of Existing Incinerator Subsystems

Objective To determine the actual state of incineration operations throughout the country and identify the areas in which work needs to be done to develop new or improved incinerator subsystems.

Schedule Initiate - FY 71 Complete - FY 73

Note: A set of guidelines incorporating current incinerator technology which can be used to assist organizations in evaluating existing incinerators and constructing new incinerators is now under development by **the CPEHS/ECA solid waste program.**

To our knowledge, there is no existing publication similar to the proposed "Incinerator Guidelines". This publication will include up-to-date technology written for the people who will make the decision. As such, it will a valuable addition to the field of knowledge.

Task E.2.

Title Incineration Research

Objective To develop incineration equipment which will more economically burn solid wastes while meeting all environmental control standards.

Incineration while one of the more common volume reduction methods, has historically been one of the worst environmental polluters. The projects proposed in this task area will evaluate new incineration concepts, explore the incinerability of various material, develop improved incinerators and strive to reduce the pollutants now being emitted by the majority of incinerators. Pyrolysis, fluidized bed and high temperature (3,000 F) will be given special attention. Incineration will probably be included as an integral part of solid waste management for many years due to the increasing scarcity of disposal sites. Any improvement in incinerator operations will be evident immediately in a cleaner environment.

Schedule Initiate - FY 71 Complete - FY 75

Task E.3.

Title Survey, Evaluate and Develop New or Improved Solid Waste Processing Subsystems

Objective To survey and evaluate existing processing subsystems and develop new or improved subsystems other than incineration which will reduce the amount of solid waste requiring disposal.

Under this broad objective will fall all Bureau work dealing with reducing the solid waste stream through methods other than those already mentioned. Included will be various physical and chemical methods; recycling, reuse or reclamation. Of initial interest will be size reduction processes, composting, compaction and baling. As such, the side effects detrimental to the environment will be kept at a minimum and resources as well as disposal sites conserved.

Schedule Initiate - FY 71 Complete - FY 75

Task E.4.

Title Upgrade Existing Solid Waste Processing Subsystems

Objective To provide assistance, etc. (technical, financial) to upgrade all existing processing subsystems to acceptable levels through the application of existing subsystems. Assistance will include technical and a major construction grants program.

Schedule Initiate - FY 71 Complete - Continuing

Task E.5.

Title Solid Waste Processing Subsystems Standards

Objective To develop and promote standards of design and operation for residential solid waste processing subsystems. If promotion fails the enforcement efforts will be necessary.

Schedule Initiate - FY 71 Complete - FY 75

Additional efforts beyond FY 75 will be needed to reflect technology, etc. changes.

Task E.6.

Title Economic-Technologic Trade-Off Studies

Objective To assess through appropriate trade-off studies, the market potential, economic impact and technologic achievability of processes presently being used or to be developed in Tasks E.2 and E.3. To assure adequate selection of those processes most likely to provide the most benefit to the total problem, etc. Such studies are needed. Subtasks might include studies that: assess the impact of complete recycling of all wastes papers; economic trade-offs needed to recycle all abandoned or obsolete automobiles; the economic ability of industry and government to provide necessary and adequate processing technology, etc.

Schedule Initiate - FY 71

Complete - Major efforts to be over the 5-year period ending in FY 75. Continuing efforts will be needed as economy/technology changes with time.

Task E.7.

Title Solid Waste Management Industry Development and Promotion

Objective The results of the research and development efforts will undoubtedly produce major new, improved, and innovative technology for the successful processing of solid wastes. These new processes will need to be effectively harnessed for the optimum impact on the present and future problem situation. Funds (grants, loans) should be provided to launch commercial, public or utility enterprises in solid waste management. It is conceivable that a General Motors or COMSAT of industrial solid wastes could be developed instead of the fragmented inept present working system. Licensing agreements could be formulated to insure optimum development.

Schedule Initiate - FY 74

Complete - Maximum expenditure through FY 79. Reduced continuing effort to meet needs thereafter.

Task Area F. Disposal

Regardless of the increase in processing technology, there will always be solid wastes which cannot be reclaimed or transformed economically into a usable form. These wastes must be submitted to ultimate disposal techniques and not allowed to accumulate.

The disposal operation should include, if possible, the reclaiming of a resource such as land, but if this is not possible, the disposal operations should not pollute the environment in any way.

Those solid wastes that cannot be reused, recycled, or reclaimed must be processed for disposal. Following processing, residues, sludges, etc. are available for disposal. Current practices include the open burning dump, sanitary landfill, and in some instances, disposal at sea. The need for final disposal is obvious to anyone who considers that some fraction of our materialistic discards have no useful value even with the most advanced technology or reuse, reclamation, recycling, etc.

This task area will determine the current disposal practices; their level of quality and effectiveness; what wastes are disposed of by what methods; the efficiencies of each method; the economics involved in each method; the technological constraints placed on each method; effect on the environment; determine the needs and types of new disposal methods (or improvements of existing methods); evaluate and determine the effects of ocean disposal on the marine ecology; propose and initiate research and development efforts to improve existing methods or develop unique methods for solid waste disposal; assess cost/benefits of any new or improved methods developed; provide for methods of demonstrating and implementing those disposal methods that appear to provide the greatest possibility of protection of the environment, cost/benefit, and technologic achievement; provide a mechanism to improve those existing subsystems worthy of modification, to eliminate all open burning dumps, operate acceptable sanitary landfills, establish standards of design and operation; and limit ocean disposal to those wastes that will not harm the marine ecology.

Since the application of the disposal unit operation will cross all wastes streams and be utilized by all management systems, this section of the plan will not differentiate between various waste sources. It is implied in the task statements that all waste sources will be studied and the application of the disposal methods will be focused on all of these waste sources.

Task F.1.

Title Current Solid Waste Disposal Practices

Objective To obtain data and information on the current disposal practices of each waste source, including the amounts and types of wastes disposed of by each method; determine the costs, etc. associated with each method-source; assess the environmental acceptability of each specific subsystem; etc.

Schedule Initiate - Active Complete - FY 75

Task F.2.

Title Evaluate Solid Waste Disposal Subsystem

Objective Conduct analyses, etc. of each disposal method to evaluate their efficiencies, economics, acceptability, applicability, effectiveness; determine the cost/benefit relationships of the method, the source, and the environment; determine the needs in improvements and new methods. Results of the task will determine efforts in tasks F.3 through F.9.

Schedule Initiate - FY 71 Complete - FY 75

Task F.3.

Title Upgrade Existing Landfill Operations

Objective To provide assistance, etc. to enable conversion of existing land disposal sites to sanitary landfills. Necessary standards will be developed. The Sanitary Landfill Guidelines presently under development by the BSWM will serve as the basic document for the development of standards.

Schedule Initiate - FY 71 Complete - FY 75

Task F.4.

Title Sanitary Landfill Research and Development

Objective To bring about improvements in sanitary landfill practices through the development of new and improved equipment and techniques for the construction and operation of sanitary landfills.

Schedule Initiate - FY 71 Complete - FY 75

Task F.5.

Title Reclaiming of Mine Shafts and Abandoned Strip Mines

Objective: To initiate and develop programs to convert abandoned mine sites into disposal operations.

There are many abandoned mine shafts in various parts of the country which might possibly be converted into disposal sites for solid wastes. Should this prove feasible, the country would realize a large increase in the amount of land available for use as disposal sites. This task will survey and evaluate existing mine sites; research and development technology for the use of these sites; develop necessary procedures, etc. to use these sites; demonstrate their application and then implement the knowledge, etc. gained.

Schedule Initiate - FY 71 Complete - FY 75

Task F.6.

Title Ocean Disposal of Solid Waste Feasibility Studies

Objective To conduct controlled pilot studies on the effect of different stable and unstable solid wastes on the marine ecology; determine possible methods of waste management of various solid wastes to determine their capability of protection of the marine ecology; test and develop those methods showing the greatest potential of success; and establish standards for disposal operations.

Schedule Initiate - FY 71 Complete - FY 75

Continuing efforts will be needed as new industrial solid wastes develop.

Task F.7.

Title Ocean Disposal Technology Development

Objective To develop equipment, techniques and practices to enable the country to use the oceans as a disposal site.

The ocean represents a largely untapped disposal site which is infinite for our purposes. However, since the ocean is also home for many species of fish and borders on lands other than our own, its use as a disposal site must be closely studied. Should methods and equipment be developed to enable the country to use the ocean, it will indeed be a boon to disposal activities in the country.

Schedule Initiate - FY 72 Complete - FY 76

Task F.8.

Title Surveillance of Ocean Disposal Operations

Objective To provide a system to assure compliance with standards established to protect the marine ecology from degradation by solid waste disposal at sea.

Schedule Initiate - FY 74 Complete - Continuing

Task F.9.

Title Demonstrate and Implement Improved Solid Waste Disposal Subsystems (include upgrading)

Objective Provide the necessary technical and financial assistance (grants, contracts, tax incentives, etc.) to public and private agencies to demonstrate and implement improved solid waste disposal subsystems, depending upon the results of Tasks F.1 and F.2 and other technology. Examples of new demonstrations might be a processing and disposal operation at sea for all demolition debris from a major metro area; regional sanitary landfills for all solid wastes of a metro area; deep well disposal of all pulp-paper sludges; etc.

Schedule Initiate - FY 73 Complete - See

Task F.10

Title Upgrading of Disposal Facilities

Objective To bring about the upgrading of all disposal sites in the country to a level at which the site will not contribute pollutants to the environment.

The disposal sites throughout the country are suspected to be grossly inadequate and improving them will involve an extremely large investment. But there is no other way to accomplish this task. Our increased technology will do no one any good unless it can be implemented and that requires **funding**.

Schedule Initiate - FY 72 Complete - Continuing

Task F.11

Title Cost/Benefit Relationships of Solid Waste Disposal

Objective To determine the cost/benefit relationships of improved disposal subsystems on the economic growth of industry, gross national profit, and the overall community prosperity.

Schedule Initiate - FY 72 Complete - FY 76

Task F.12

Title Solid Waste Disposal Standards

Objective To establish and promote standards of design and operation for all solid waste disposal methods. If promotional work does not succeed in attaining the standards, then, enforcement efforts will be required.

Schedule Initiate - FY 71 Complete - Continuing

Task Area G - Management

Although improved solid waste technology is essential to provide long run solutions to the growing problems of solid waste storage, collection, transport, processing and disposal; existing technology would be sufficient to reduce environmental insults if it were applied properly. The major component of our present solid waste problem is poor management, no management, or mismanagement. In every society and in every field of endeavor the primary prerequisite to developing new technology is to assure that existing technology can be and is being applied optimally. This, of course, requires considerable interaction between technologic areas and those economics, finance, planning, legislation, manpower development, education and a number of other socio-political-economic fields and institutions.

This task area will study the present management practices, develop an understanding of these present practices, and the constraints associated with these practices; probe the interfaces in solid waste management; determine the manpower and dollars needed to effectively manage the nation's solid wastes; develop concepts for more effective management; implement those concepts that show the greatest promise of success, i. e. technically, financially, etc.; provide the legal and management base to provide the best possible management systems for solid waste; and establish an overall control system to assure that new, bold, and innovative techniques are applied to operating systems and that standards of excellence are maintained by operating systems.

Since the application of the management concepts, etc. will cross all wastes streams and be utilized by all management systems, this section of the plan will not differentiate between various waste sources. It is implied in the task statements that all waste sources will be studied and application of the concepts etc. will be focused on all of these waste sources.

Task G.1

Title Interfaces in Solid Waste Management

Objective To assess through surveys, studies, etc. the current management practices of solid waste. Because of the diverse manner of solid waste management studies must be made to determine what wastes go where, why they go where they go, who has legislative control over those wastes, etc. Questions relative to the enforcement of standards of on-site systems must be investigated. The needs and methods of combined industrial-government systems need to be explored coupled with a very in-depth study of citizen-industry-government attitudes about the relationships between the three groups.

Schedule Initiate - FY 71 Complete - FY 73

Task G.2.

Title Attitudes Toward Solid Waste Management

Objective To study and define the attitudes of citizens, government, industry, management, etc. to solid waste thereby developing basic understandings that can be used to influence the allocation of more resources to solid waste management.

Schedule Initiate - FY 72 Complete - FY 74

Task G.3.

Title The Costs of Solid Waste Management

Objective To determine for each solid waste management unit operation the costs for the present level of management and project costs through the year 2000. Previous tasks in this plan will provide initial input to this task.

Schedule Initiate - FY 72 Complete - FY 74

Task G.4.

Title Manpower in Solid Waste Management

Objective To determine for the present manpower allocations for solid waste management and project the needs through the year 2000.

Schedule Initiate - FY 72 Complete - FY 74

Task G.5.

Title Residential Solid Waste Management Training and Manpower Development

Objective To develop operating and management manpower resources for all solid waste management systems in the United States.

Schedule Initiate - 1971 Complete - Continuing

Task G.6.

Title Improved Management of Solid Waste Through Solid Waste Management Planning

Objective To assure that attempted solutions to manage solid waste systems in an orderly manner, consistent with environmental, economic, social and other institutional objectives.

Schedule Initiate - FY 70 Complete - FY 78

Task G.7.

Title Optimal Application of Existing Technology

Objective Through the mechanisms of direct assistance (technical and financial), public relations, national, regional and local seminars, and other potential alternatives, to improve solid waste management practices by a more efficient (technologic, economic, aesthetic, health) application of available technology.

Schedule Initiate - FY 70 Complete - FY 78

Task G.8.

Title Solid Waste Cost-Management Development

Objective To review and evaluate existing cost accounting, financial management and management information practices and to develop and improve systems and techniques that can provide a rapid control and evaluation of solid waste management decisions and their related implications.

Schedule Initiate - 1971 Complete - 1975

Task G.9.

Title Systems Applications for Improving Solid Waste Management Practices

Objective To review, evaluate, modify, develop and apply systems analysis and related operations research techniques to improving the operation of the solid waste management systems.

Schedule Initiate - FY 71 Complete - Continuing

Task G.10.

Title Legislative Inter-relationships

Objective To define the present legislative constraints at the Federal, state, and local government levels that prevent necessary improvements or involvement in effective solid waste management systems; and to develop methods that will encourage and implement desired legislative changes, additions, etc. for such improvements and involvement.

Schedule Initiate - FY 72 Complete - FY 75

Task G.11.

Title Waste Management Through Regulation - Incentives

Objective To explore the feasibility of promulgating regulations or profit incentives to assure that product design will include process and disposal design; to determine the impact of such methods on industry growth and innovation; and to evaluate the effect on markets in the United States and world-wide.

Schedule Initiate - FY 72 Complete - FY 75

Task G.12.

Title Cost/Benefit Studies of Solid Waste Financing

Objective To explore current methods of financing solid waste management systems, determine the effect such financing has on industry growth; community development, etc.; and to determine alternate methods of financing to stimulate the provision of needed systems while not hindering economic growth.

Schedule Initiate - FY 72 Complete - FY 74

Task G.13.

Title Industry Involvement in Government Solid Waste Management

Objective To develop an understanding of the relationship between industry and the selection and operation of government solid waste management systems; and to determine where industry techniques can be applied to government systems.

Schedule Initiate - FY 72 Complete - FY 74

Task G.14.

Title Evaluation and Assessment of Environmental Interfaces

Objective To assess and evaluate in detail the interrelationships between solid waste management and other environmental or resources oriented fields.

Schedule Initiate - 1971 Complete - 1972

Task G.15.

Title Socio-Political-Economic Factors in Waste Management

Objective To investigate and analyze existing social, political, economic, financial, legal and other institutional structures, to assess the impact of these factors on the field waste management, and to develop and apply new concepts that maximize the application of more optimal solutions to solid waste management practices.

Schedule Initiate - Active Complete - Continuing